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Contract NAS8-29622

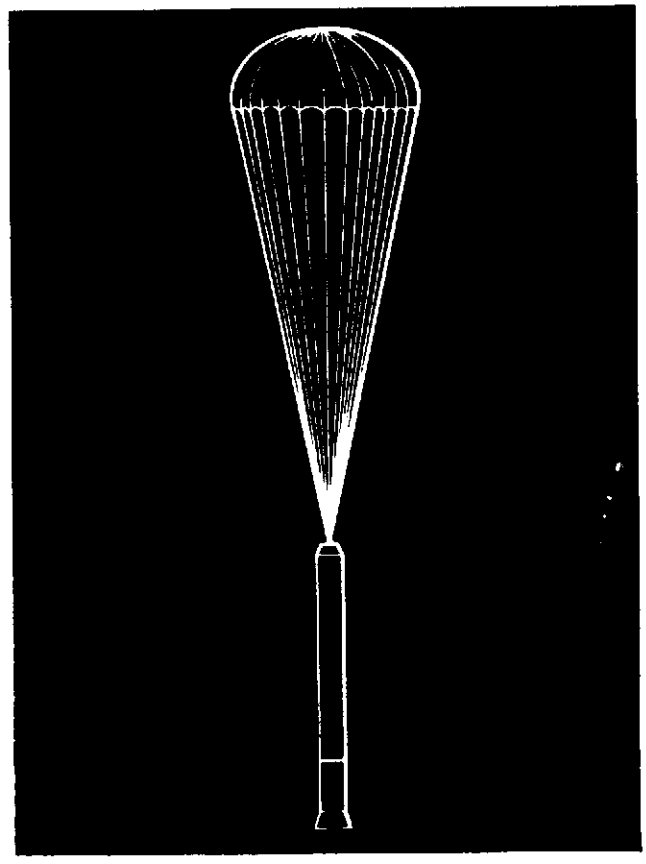
Volume II

User's Manual

October 1973

SRB Water Impact Monte Carlo Computer Program

Space Shuttle Solid Rocket Booster Recovery System Definition



MARTIN MARIETTA

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SRB Water Impact
Monte Carlo
Computer Program

SPACE SHUTTLE SOLID ROCKET BOOSTER RECOVERY SYSTEM DEFINITION

Approved

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FOREWORD

This report is submitted in three volumes to the National Aeronautics and Space Administration, Marshall Space Flight Center, in partial fulfillment of the requirements of Contract NAS8-29622.

The objective of this contractual effort has been to define performance requirements, preliminary designs, and development program plans for an airborne recovery system for the Space Shuttle Solid Rocket Booster, with minimum total program costs being the primary selection criterion.

Volume I, entitled *Technical Report, Space Shuttle Solid Rocket Booster Recovery System Definition*, contains the results of all analyses performed during the study term to define the performance requirements, preliminary designs, and development program plans for the SRB Recovery Subsystem.

Volumes II and III contain user's instructions for two computer programs developed in support of the contract technical studies. Volume II is entitled *Solid Rocket Booster Water Impact Monte Carlo Computer Program* and Volume III is entitled *Solid Rocket Booster Water Impact Loads Computer Program*.

CONTENTS

FIGURE

SUMMARY

The HD 220 program was created as part of the Space Shuttle Solid Rocket Booster Recovery System Definition under Contract NAS8-29622. The model was generated to investigate the damage to SRB components under water impact loads. The random nature of environmental parameters, such as ocean waves and wind conditions, necessitates estimation of the relative frequency of occurrence for these parameters. The nondeterministic nature of component strengths also lends itself to probabilistic simulation. The Monte Carlo technique allows the simultaneous perturbation of multiple independent parameters and provides outputs describing the probability distribution functions of the dependent parameters. This allows the user to determine the required statistics for each output parameter.

The program uses 65,000 octal core locations and has a running time of approximately 20 seconds per terminal descent velocity for 1000 Monte Carlo trials.

1.0 INTRODUCTION

The determination of SRB attrition resulting from water impact required the development of a statistical model of all parameters contributing to the water entry conditions. The random nature and non-Gaussian distributions of many of these parameters made the problem well suited to the Monte Carlo statistical method.

The SRB Water Impact Computer Program developed during the study is documented in this volume. The computer program is written in FORTRAN IV language for the CDC 6400/6500 series digital computer. The cognizant engineers are Messrs. K. E. Bassett and M. G. Brunschwig. The computer programming was performed by Mr. W. S. Lakins.

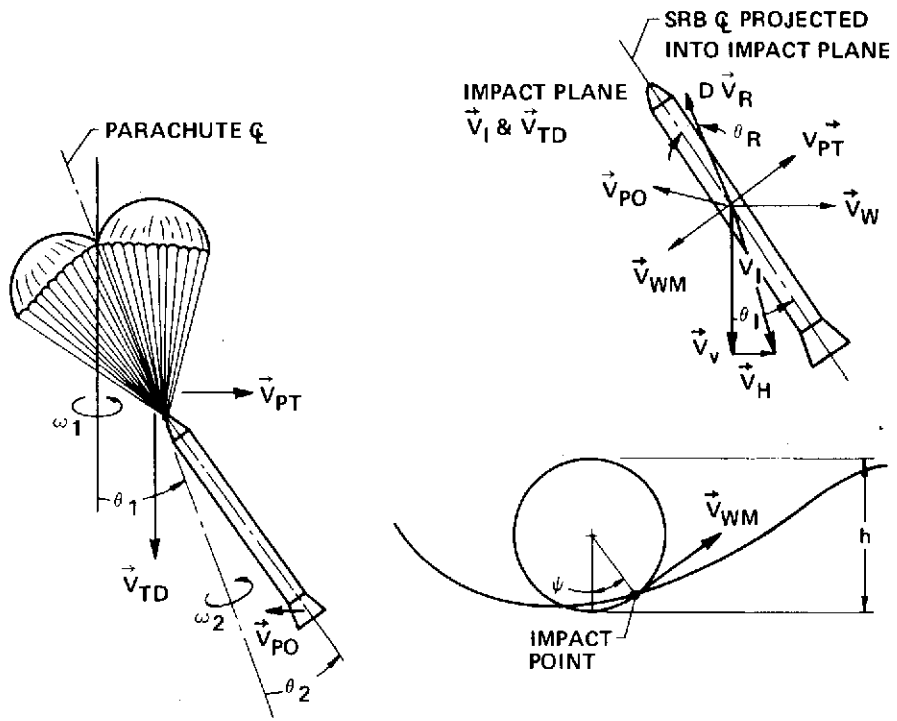
2.0 PROGRAM DESCRIPTION

The Monte Carlo water entry model uses probability distributions to describe such environmental parameters as water current, water mass velocity, and wind velocity. In addition, recovery system parameters are modeled in terms of their probability distributions: parachute terminal descent velocity, parachute translation velocity due to lift, parachute rotational velocity (at SRB nozzle), oscillation angles of parachute and SRB, rotation rates, and retromotor parameters, if used (Figure 2-1).

The Monte Carlo analysis consists of randomly selecting the parameters which influence water entry conditions from their respective probability distributions, vectorially combining these parameters at the water entry point, and determining impact velocity and angle distributions that define the entry loading conditions on the SRB.

The macrologic for the computer model is illustrated in Figure 2-2. Random number generators (seeded by clock time) are used to select environmental and physical parameters from their cumulative probability distributions. Each input parameter is selected using a different random number to assure a realistic unbiased simulation. The parameters are vectorially combined using 3-D kinematic equations to obtain the vertical (V_V) and horizontal (V_H) components of the impact velocity. The impact attitude (θ_I) is the angle between vertical and the projection of the SRB centerline into the impact (V_V, V_H) plane. Probability distributions for V_V, V_H, and θ_I are outputs of the simulation. These distributions allow calculation of impact statistics such as the mean and standard deviation for each parameter.

Five structural components are considered in the load analysis; forward skirt, aft skirt, nozzle (with or without extension), SRB case and the aft dome. Loads are input as trivariant tables in terms of V_V, V_H, and θ_I. The model uses linear table lookup to perform trivariate interpolation for the component loads. The structural strength, being a nondeterministic quantity, is selected randomly from the component strength distributions that are input as data statements. Except for the SRB case, component attrition occurs when the load exceeds the strength. The SRB case is assumed



IMPACT LOAD = $f(V_v, V_H, \theta_I)$

PARACHUTE DESIGN = $f(V_{TD})$

$V_{TD} = \bar{V}_v - \bar{V}_{WM} \sin \psi$

LEGEND:

θ_I	IMPACT ATTITUDE ANGLE
$\vec{V}_I$	IMPACT VELOCITY
V_v	VERTICAL COMPONENT OF V_I
V_H	HORIZONTAL COMPONENT OF V_I
$\vec{V}_{TD}$	TERMINAL DESCENT VELOCITY
$\vec{V}_W$	WIND VELOCITY
$\vec{V}_{PT}$	PARACHUTE TRANSLATION VELOCITY DUE TO LIFT
$\vec{V}_{PO}$	PARACHUTE ROTATIONAL VELOCITY AT THE NOZZLE
$\vec{V}_{WM}$	WAVE MASS VELOCITY
$\vec{V}_{CUR}$	CURRENT VELOCITY
θ_1	OSCILLATION ANGLE OF PARACHUTE
θ_2	OSCILLATION ANGLE OF SRB ABOUT PARACHUTE ℄
ω_1	ROTATION RATE OF PARACHUTE ABOUT VERTICAL
ω_2	ROTATION RATE OF SRB ABOUT PARACHUTE ℄
h	WAVE HEIGHT
ψ	WAVE MASS DIRECTION ANGLE
θ_{WM}	WAVE DIRECTION ANGLE
θ_{CUR}	CURRENT DIRECTION ANGLE
ψ_1, ψ_2	AZIMUTH OF PROJECTIONS OF PARACHUTE, SRB ℄
$D\vec{V}_R$	RETROMOTOR ΔV (IF APPLICABLE)
θ_R	RETROTHRUST MISALIGNMENT IN IMPACT PLANE (TO SRB ℄)

Figure 2-1 Impact Related Variables Defined by Environmental and State Vector Uncertainties

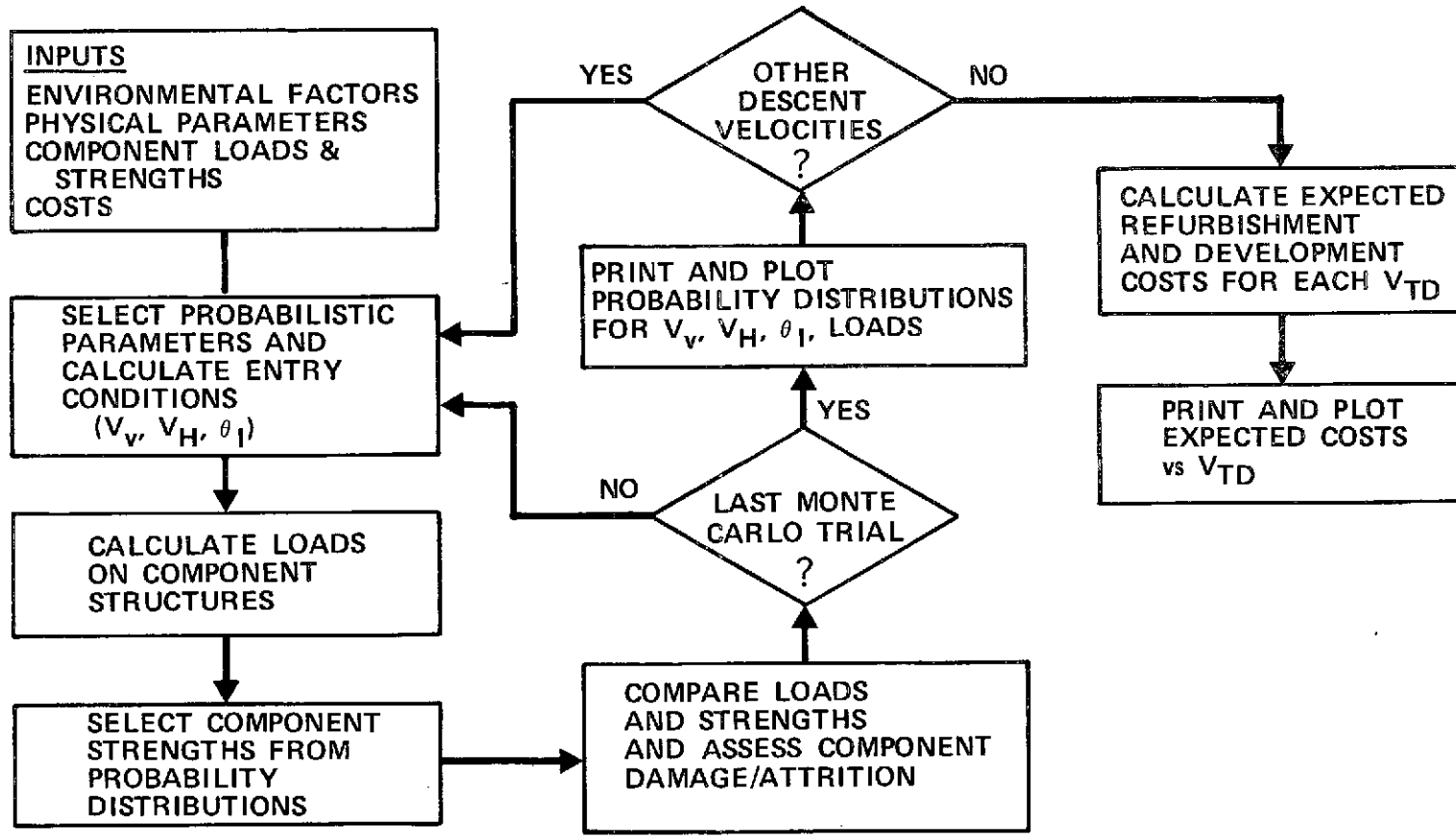


Figure 2-2 Monte Carlo Analysis Macrologic

to rupture and sink when a 20% overload occurs during SRB slap-down. Attrition of two case segments is assumed for overloads less than 20%.

This procedure determines attrition for one randomly selected set of parameters. To obtain reliable statistics, the procedure is repeated for many sets of parameters. The model has storage capability for 2000 Monte Carlo trials of a given terminal descent velocity. The outcome (attrition) for each structural component is accumulated over the total number of trials and used to formulate the attrition statistics for each V_{TD}.

A simplified cost estimate procedure using the refurbishment and component replacement costs serves to assess the minimum SRB structural attrition versus impact velocity. When component refurbishment costs are multiplied by the attrition probabilities and summed over all components, a resultant SRB refurbishment cost curve is obtained as a function of terminal descent velocity.

3.0 SUBROUTINE DESCRIPTIONS

3.1 SRB

This routine provides control over the entire program. Input data is read in Namelist format (described in Section 4.0). This routine initializes all variables and calculates the three impact parameters (horizontal velocity, vertical velocity, and impact angle).

The flow chart for the SRB routine is shown in Figure 3-1. Each input terminal descent (design) velocity (V_{TD}) is used in turn to determine impact statistics. The routine contains coding for both planar and three degrees of freedom (3 DOF) calculations. Random number generators are used to calculate parameter values which are added at the impact point to determine impact velocity and angle.

This routine also calls LOADS to determine component failures. After all the Monte Carlo trials for a given V_{TD} have been run, the next V_{TD} is read and a new set of trials are run. When all statistics for each V_{TD} have been accumulated, HIST is called to create histograms. The cost (per SRB) is calculated for each V_{TD} and COSTPLT is called to plot the results.

3.2 WAVE

This routine calculates the wave direction correlated to the wind direction. An input probability distribution is used for the calculation.

3.3 SLAP

This routine determines if damage has occurred to the SRB case under conditions of maximum slapdown. The routine is called from LOADS and takes the actual pressure (P_a) generated from the maximum slapdown condition and generates a critical pressure (P_c) from a strength probability distribution. Three conditions are possible:

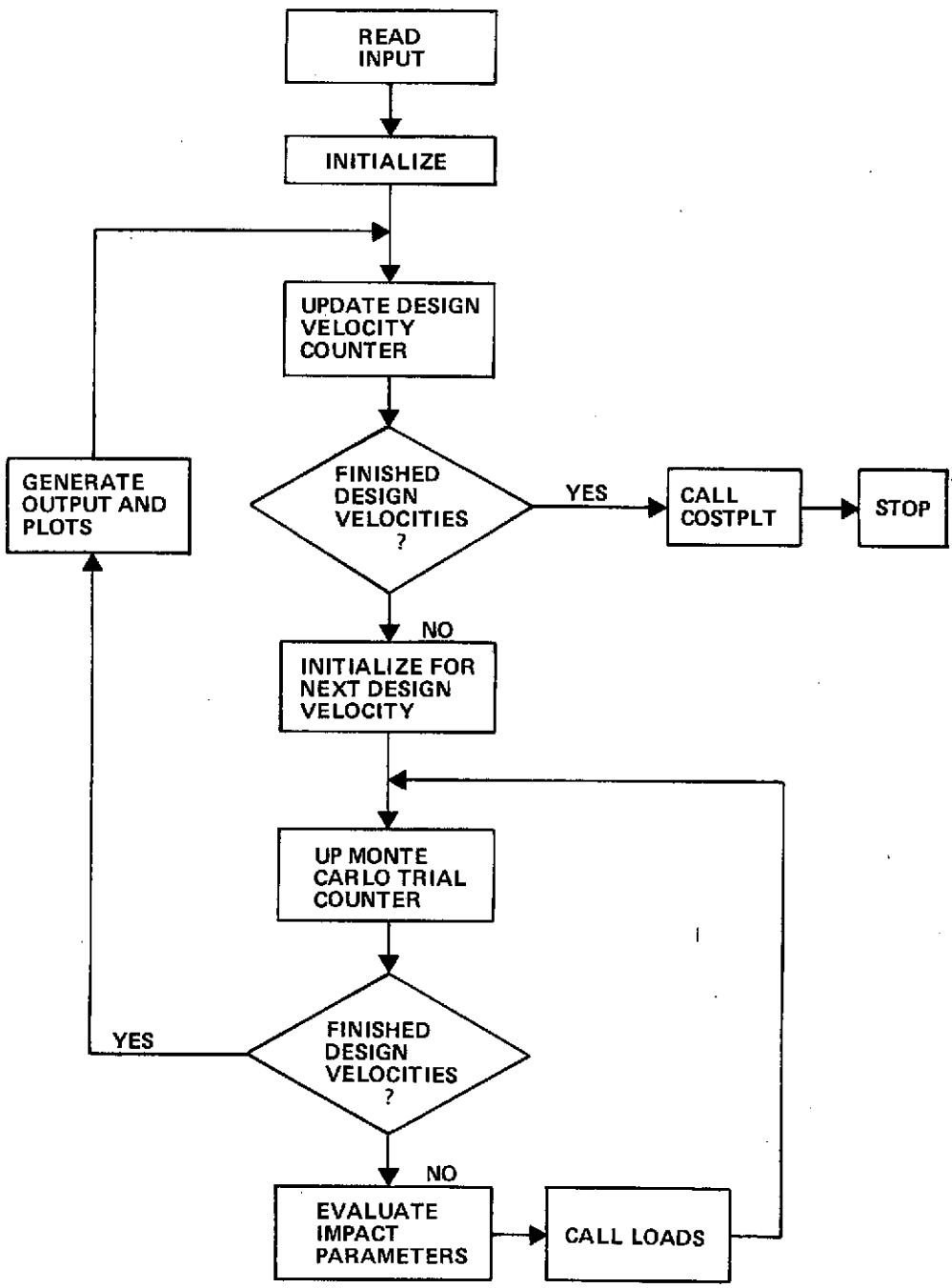


Figure 3-1 Flow Chart for Subroutine SRB

1) $P_a \geq 1.2\ P_c$ results in the SRB rupturing and sinking;

2) $P_c \leq P_a < 1.2\ P_c$ results in damage to two case segments;

3) $P_a < P_c$ results in no damage.

Capability exists for using a bivariate case strength distribution in terms of load and pressure but case strength is presently input only in terms of SRB case hoop moment.

3.4 STREN

This routine is called from LOADS and makes a load/strength comparison to determine if failure has occurred to any of the other components (nozzle, aft dome, aft skirt, and forward skirt).

3.5 HIST

This routine is called from SRB and generates a histogram for many of the variables. HIST calls SORX to sort the array of values in ascending order and then uses 5% increments of the number of trials (NUMMC) to generate a 20-point histogram representing the probability distribution for each variable. The routine also calculates the parameter statistics such as: mean, standard deviation, median, maximum and minimum values, and the 99% value.

3.6 PLOT

This routine is called from SRB and plots the probability distributions for various parameters.

3.7 WIND

This routine calculates the wind velocity (and direction) at three altitudes (1 km, canopy height, 19.3 m reference) using a correlated bivariate Gaussian distribution of zonal and meridianal wind in the recovery zone (NASA YA-25-23). The calculation is made using a Guassian random number generator and a covariance matrix of coefficients for wind components for each month of the year. Variation of wind with altitude is calculated using equations obtained from NASA (YA-62-72).

3.8 SORX

This routine takes an input array of values, sorts it into ascending order and replaces it in the original array. No additional computer core is required to perform this sort.

3.9 LOADS

This routine is called from SRB and contains (as data statements) all the trivariate load tables (in terms of V_V, V_H, θ_I) and strength probability distributions for the SRB components. Component loads are determined from the impact variables and SLAP (for the case slapdown damage) and STREN are called to determine the component damage which updates a damage condition summary array. LOADS also collects (in arrays) parameter values that are output as statistics by HIST.

3.10 TRIVAR

This routine performs a trivariant linear interpolation for three impact angles, three horizontal velocities and five vertical velocities using the tables in LOADS.

3.11 WRIT

This output routine is called from SRB. It outputs the damage condition summary as well as summary load data. This includes the total attrition for each component as well as percentage damage.

3.12 XYZ

This routine fits a biparabolic function through the points input to it. It is called from COSTPLT.

3.13 EVAL

This function is called from COSTPLT and uses the output from XYZ to interpolate between known points.

3.14 COSTPLT

This routine is called from SRB. COSTPLT plots the cost for each terminal design velocity and interpolates between them to draw a smooth curve. This routine also terminates the run.

4.0 INPUT FORMATS

Input to the program is done through namelist type input. The format for namelist is a $ in column 2, followed immediately by the namelist name and at least one blank, then the parameters are defined and separated by commas. A sample input listing is given in Section 6.0. Column 1 is reserved for comment cards using a C (or P in the case of the namelist) to allow it to be printed:

Column

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P	$	I	N	P	U	T	1		I	X	X	=	0	,		

The terminator of the namelist is a $ which follows the last input value.

4.1 Namelist INPUT1:

This is the first namelist in the input stream.

NUMMC — the total number of Monte Carlo trials (maximum 2000) to be calculated per terminal design velocity;

NUMVTD — the total number of terminal design velocities (maximum 10)

IXX — a flag to indicate whether nozzle moment uses table data for an SRB with nozzle extension or without nozzle extension:

If IXX = 0, no nozzle extension is used; if IXX $\neq$ 0, nozzle extension is used.

IRANF — flag to indicate whether the user wants a repeatable random sequence or a nonrepeatable sequence.

4.2 Namelist INPUT2:

W1IN — maximum limit of distribution for ω_1, the rotation rate of the parachute about vertical (rad/s). The distribution is uniform from -W1IN to +W1IN.

W2IN — maximum limit of distribution for ω_2, the rotational rate of the SRB about the parachute centerline (rad/s). The distribution is uniform from -W2IN to +W2IN.

TH1IN — distribution limit for θ_1, the oscillation angle of the parachute centerline to the vertical (rad). The distribution is uniform from 0 to TH1IN.

TH2IN — distribution limit for θ_2, the oscillation angle of the SRB centerline to parachute centerline (rad). The distribution is uniform from 0 to TH2IN.

Note: For planar problems θ_1 and θ_2 are combined and an arcsine distribution is available in the coding.

VPTIN — mean for parachute translation velocity due to lift (m/s).

VPTSIG — standard deviation for parachute translation velocity calculations (m/s).

XLP — length of the parachute shroud lines in meters.

VCRNT — mean value of water current velocity (m/s).

VCRNTSI — standard deviation of water current velocity (m/s).

PTHW — array that has probability distribution for wave direction (9 values).

THW1 — array of angles (rad) corresponding to the probability values in PTHW (9 values).

Sample array input (can be all in one sequence or broken up as shown):

Column

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	P	T	H	W	(	1	)	=	3	*	.	5	,
	P	T	H	W	(	4	)	=	6	*	1	.	,

4.3 Namelist COSTS

COST — array with cost of refurbishment for SRB components.

COST(1) — cost of refurbishment for condition of no component damage.

COST(2) — cost for replacement of sunk SRB (new SRB Cost)

The following are delta costs between new item purchase and refurbishment cost:

COST(3) — delta cost for case damage (2 segments).

COST(4) — delta cost for forward skirt.

COST(5) — delta cost for nozzle.

COST(6) — delta cost for aft dome.

COST(7) — delta cost for aft skirt.

4.4 Namelist INPUT 3

VTDIN — mean value for calculation of the terminal design velocity in m/s.

VTDSIG — sigma for calculation of the terminal design velocity (m/s).

THETAMR — distribution limit for retromotor thrust vector misalignment (rad). The distribution is uniform from -THETAMR to +THETAMR.

DVRMEN — mean value of retromotor ΔV (m/s).

DVRSIG — standard deviation for retromotor ΔV (m/s).

Namelist INPUT3 is repeated NUMVTD times with the mean and sigma for each terminal velocity to be investigated.

4.5 Input File

$^{7}_{8}{}_{9}$ (alpha card)

```
$ INPUT1   NUMMC    = 2000,   NUMVTD  = 2  , . . . $
$ INPUT 2  W1IN     = 0.01, . . . . . $
$ COSTS    COST(1)  = 0.826E+6. . . . . $
$ INPUT3   VTDIN    = 2.0,  VTDSIG  = 0.5        $ } Repeat for each
$ INPUT3   VTDIN    = 3.0,  VTDSIG  = 0.07       $ } V_TD (NUMVTD cards)
```

$^{6}_{7}{}_{8}{}_{9}$ (beta card)

```
      PROGRAM SRB(INPUT  ,OUTPUT  ,FILMPL  ,TAPE5=INPUT  ,TAPE6=OUTPLT )
C-----------------------------------------------------------------------
C                    **** VARIABLE DEFINITIONS ****
C     W1 -----  ROTATION RATE ABOUT PARACHUTE CL
C     W2 -----  ROTATION RATE (SRB ABOUT CHUTE CL)
C     TH1 ----  OSCILLATION ANGLE (CHUTE CL TO VERTICAL)
C     TH2 ----  OSCILLATION ANGLE (SRB CL TO CHUTE CL)
C     VTO ----  TERMINAL DESCENT VELOCITY
C     VPT ----  TRANSLATIONAL VELOCITY
C     VWIND --  VELOCITY OF WIND
C     VWM ----  VELOCITY OF WAVE MOTION
C     THWM ---  DIRECTION OF WAVE MOTION
C     THCUR --  DIRECTION OF CURRENT (PERP TO THWM)
C     PH1 ----  ROTATION ANGLE OF CHUTE
C     PH2 ----  ROTATION ANGLE OF SRB
C     PST ----  WAVE MASS ANGLE
C     THETIR -  MISSALIGNMENT OF RETRO THRUST IN IMPACT PLANE
C     DVR ----  VELOCITY OF RETRO ( DELTA VELOCITY )
C-----------------------------------------------------------------------
000002      DIMENSION  PTHW(9)            ,THW1(9)        ,THIMPAC(2000)  ,
     1              VHORIZN(2000)        ,VRTICAL(2000)  ,MON(12)        ,
     1              CSTVT(10)            ,TER(10)        ,COST(7)
C-----------------------------------------------------------------------
C                       **** COMMON DEFINITIONS ****
C     COMMON / TITLE /
C                      ITITLE --- TITLES FOR PLOTS AND/OR PRINT-OUT
C     COMMON / DAMAG /
C                      IFAL    --- DAMAGE CONDITION COUNTER FOR VELOCITY
C                      IFAL(1) -- COUNTER FOR NO DAMAGE
C                      IFAL(2) -- COUNTER FOR SINKAGE
C                      IFAL(3) -- COUNTER FOR CASE DAMAGE
C                      IFAL(4) -- COUNTER FOR FORWARD SKIRT
C                      IFAL(5) -- COUNTER FOR NOZZLE
C                      IFAL(6) -- COUNTER FOR AFT DOME
C                      IFAL(7) -- COUNTER FOR AFT SKIRT
C     COMMON / NUMBER /
C                      NUMMC --- TOTAL NUMBER OF MONTE CARLO TRIALS
C     COMMON / STAT /
C                     STAT  --- STATISTICS FOR PRINT OUT
C     COMMON / CSTDAT /
C                      PER  --- PER CENT OF TOTAL TRIALS WITH EACH DAMAGE
C                               CONDITION
C     COMMON / CNDTNS /
C                      FVIZ --- IMPACT - VERTICAL VELOCITY FOR TRIAL
C                      FVH  --- IMPACT - HORIZONTAL VELOCITY FOR TRIAL
C                      DTHI --- IMPACT - ANGLE FOR TRIAL
C                      VVEL --- TABLE VALUES FOR VERTICAL VELOCITY
C                      VHOR --- TABLE VALUES FOR HORIZONTAL VELOCITY
C                      THETA -- TABLE VALUES FOR IMPACT ANGLE
C     COMMON / MAXSLP /
C                      ACTPRESS - ARRAY FOR STORAGE OF ACTUAL PRESSURE
C                                 ON CASE
C                      CRTPRESS - ARRAY FOR STORAGE OF CRITICAL PRESSURE
C                                 ON CASE
C                      XNSAV  --- ARRAY FOR STORAGE OF LOAD ON CASE
```

```
C                    FXNSAV --- ARRAY FOR STORAGE OF LOAD ON CASE
C                               FOR CASE FAILURE
C                    FACTFS --- ARRAY FOR STORAGE OF ACTUAL PRESSURE
C                               ON CASE FOR FAILURE
C-----------------------------------------------------------------------
000002       COMMON   / TITLE  /  ITITLE(60)
000002       COMMON   / DAMAG  /  IFAL(7)
000002       COMMON   / STAT   /  STAT(24)
000002       COMMON   / NUMBER /  NUMMC
000002       COMMON   / CSTDAT /  REP(7)
000002       COMMON   / CNDTNS /  EVIZ  ,EVH  ,DTHI  ,VVEL(5)  ,VHOR(3)  ,
            1                     THETA(3)
000002       COMMON   / MAXSLP /  ACTPRES(2000)  ,CRTPRES(2000)  ,XNSAV(2000)
000002       NAMELIST / INPUT1 / NUMMC ,NUMVTD  ,IXX  ,IRANF
C
C ---  NUMMC -- THE TOTAL NUMBER OF MONTE CARLO TRAILS (2000 MAX)
C ---  NUMVTD - THE NUMBER OF TERMINAL DESIGN VELOCITIES (10 MAX)
C ---  IF IXX IS NON-ZERO, HAVE NOZZLE EXTENSION
C ---  IF IRANF IS NON-ZERO CREATE REPEATABLE RANDOM SEQUENCE
C
000002       NAMELIST / INPUT2 / W1IN  ,W2IN  ,TH1IN  ,TH2IN  ,VPTIN  ,VPTSIG ,
C
C ---  W1IN - UNIFORM DISTRIBUTION FOR W1 (-W1IN TO W1IN)
C ---  W2IN - UNIFORM DISTRIBUTION FOR W2 (-W2IN TO W2IN)
C ---  TH1IN - UNIFORM DISTRIBUTION FOR TH1 (0 TO TH1IN)
C ---  TH2IN - UNIFORM DISTRIBUTION FOR TH2 (0 TO TH2IN)
C ---  VPTIN - MEAN FOR TRANSLATIONAL VELOCITY
C ---  VPTSIG - SIGMA FOR TRANSATIONAL VELOCITY
C
     1                        PTHW  ,THW1  ,XLP    ,VCRNT  ,VCRNTSI  ,
C
C ---  PTHW - ARRAY WITH PROBABILITY RANGE FOR WIND DIRECTION
C ---  THW1 - ARRAY WHICH CORRESPONDES TO PTHW VALUES FOR WAVE DIRECTION
C ---  XLP - LENGTH OF PARACHUTE SHROUD LINES
C ---  VCRNT - MEAN CURRENT VELOCITY
C ---  VCRNTSI - SIGMA FOR VCRNT
C
     2                        THETAMR  ,OVRMEN  ,OVRSIG
C
C ---  THETAMR - UNIFORM DISTRIBUTION FOR THETAR (-THETAMR TO THETAMR)
C ---  OVRMEN  - MEAN FOR RETRO VELOCITY ( DELTA VELOCITY )
C ---  OVRSIG  - SIGMA FOR RETRO VELOCITY ( DELTA VELOCITY )
C
000002       NAMELIST / INPUT3 / VTOIN  ,VTOSIG
C
C ---  VTOIN - MEAN VALUE FOR DESIGN VELOCITY
C ---  VTOSIG - SIGMA FOR VTOIN
C
000002       NAMELIST / COSTS /  COST
C
C      COST --- ARRAY FOR REFURBISHMENT COST FOR DAMAGE CONDITIONS
C               ORDER MUST BE SAME AS ORDER IN PRINT-OUT
C               (SEE SUBROUTINE WRIT)
C
000002       DATA TWOPHI ,YLS ,FTMT  ,RAD / 6.283184  ,40.2  ,3.28  ,57.3  /
```

```
000002          DATA  VVEL  /  40.  ,60.  ,80.  ,100.  ,130./
000002          DATA  VHCR  /  0.   ,25.  ,50.  /
000002          DATA  THETA /  -10.  ,0.  ,10.  /
000002          READ(5,INPUT1)
                C ---  LOGIC FOR REPEATABLE SEQUENCE
000005          IF(IRANF .EQ. 0)  GO TO 1
000006          X  =  RANF(+100)
000011          GO TO 5
000011    1     CALL TIME(N)
000013          X  =  RANF(-N)
000017    5     CALL EPLT(2HMR  ,2HLG )
                C-----------------
                C    THE FOLLOWING BLOCK OF CODE IS TO ZERO VARIABLES THAT THE COMPUTATION
                C    OF ARE COMMENTED OUT
000021          W1      =  0.
000022          W2      =  0.
000022          TH1     =  0.
000023          PH1     =  0.
000023          THP     =  0.
000024          VPT     =  0.
000024          VPTX    =  0.
000025          VPTY    =  0.
000025          STH1    =  0.
000026          CTH1    =  1.
000027          SPH1    =  0.
000030          CPH1    =  1.
000031          AMULT   =  0.
000031          ATEMP   =  0.
000032          VPOX    =  0.
000033          VPOY    =  0.
000033          VPOZ    =  0.
                C----------END OF BLOCK
000034          KNTMC   =  0
000034          KNTVTD  =  0
000035          READ(5,INPUT2)
000040          READ(5,COSTS)
000043          XNC  =  NUMMC / 12.
000046          CALL WAVE(0  ,PTHW  ,THW1  ,X  ,X  )
000051    10    KNTVTD  =  KNTVTD + 1
000053          IF(KNTVTD .GT. NUMVTD)     CALL COSTPLT(CSTVT  ,NUMVTD  ,TER  )
000057          IFAIL  =  0
000060          KNTMC   =  0
000061          DO 15 I=1,12
000065          MONTH(I)  =  0
000066    15    CONTINUE
000067          DO 17 I=1,7
000073          IFAIL(I)  =  0
000074    17    CONTINUE
000075          DO 18 I=1,24,3
000103          STAT(I)     =  0.
000104          STAT(I+1)   =   1.0E+20
000104          STAT(I+2)   =  -1.0E+20
000105    18    CONTINUE
000106          READ(5,INPUT3)
000110          TER(KNTVTD)  =  VTDIN
```

```
000112    20    KNTMC  =  KNTMC + 1
000114          IF(KNTMC .LE. NUMMC)    GO TO 25
000116          WRITE(6,1001)   VTOIN
000123          CALL WRIT(VTOIN )
000125          WRITE(6,1002)   (MON(I),I=1,12)
000133          IF(KNTVTO .GT. 1)    GO TO 35
000137          CALL HIST(THIMPAC  ,NUMMC  ,3  )
000141          CALL PLOT(13  ,NUMMC  ,-.5  ,.1  ,THIMPAC  )
000145          CALL HIST(VHORIZN  ,NUMMC  ,2  )
000150          CALL PLOT(7  ,NUMMC  ,0.0  ,2.  ,VHORIZN  )
000154    35    CALL HIST(VRTICAL  ,NUMMC  ,1  )
000157          CALL PLOT(1  ,NUMMC  ,VTOIN-10.  ,2.  ,VRTICAL  )
          C     CALL HIST(XNSAV  ,NUMMC  ,4  )
          C     CALL PLOT(19  ,NUMMC  ,0.0  ,2000.  ,XNSAV  )
000165          CALL HIST(ACTPRES  ,NUMMC  ,5  )
000170          CALL PLOT(25  ,NUMMC  ,0.0  ,2000.    ,ACTPRES  )
000174          CALL HIST(CRTPRES  ,NUMMC  ,6  )
000177          CALL PLOT(31  ,NUMMC  ,0.0  ,2000.,    CRTPRES  )
          C --- CALCULATE COST FOR TERMINAL VELOCITY
000203          CSTVT(KNTVTO)  =  0.
000205          DO 22 I=2,7
000212          CSTVT(KNTVTO)  =  CSTVT(KNTVTO) + PER(I) * COST(I)
000214    22    CONTINUE
000215          CSTVT(KNTVTO) = CSTVT(KNTVTO) +( 1. - PER(2) )* COST(1)
000221          GO TO 10
000222    25    CONTINUE
          C5    W1       =  2. * W1IN * RANF(0) - W1IN
          C     W2       =  2. * W2IN * RANF(0) - W2IN
          C     TH1      =  TH1IN * RANF(0)
          C     TH2      =  TH2IN  * (RANF(0) - .5 )
          C ---- ASSUME PLANAR MOTION IN WIND PLANE
000222          TH2      =  SIN(TWOPHI / 2. * (RANF(0) - .5)) * TH2IN
          C ---- TH2DOT FOR PLANAR MOTION IN WIND PLANE
000232          TH2DOT   =  W2IN * COS(TWOPHI / 4. * TH2 / TH2IN)
                *        *  SIGN(1  ,RANF(0) - .5  )
000250          CALL WIND(MON  ,XNC  ,KNTMC  ,VWIND  ,VKM  ,THW  ,XLS + XLP  )
000260          CALL WAVE(1,  PTHW  ,THW1  ,THWM  ,THW  )
000264          THOUR    =  (TWOPHI / 2. ) * RANF(0)
          C     PH1      =  TWOPHI *( RANF(0) - .5 )
          C     PH2      =  TWOPHI * RANF(0)
          C ---  ASSUME PLANAR MOTION IN WIND PLANE
000270          PH2      =  THW
000272          PSI      =  TWOPHI * ( RANF(0) - .5 )
          C     THP      =  TWOPHI * ( RANF(0) -  .5 )
000277          CALL SPNRN1(VCRNT  ,VCRNTSI  ,VCURNT  )
          C     CALL SPNRN1(VPTIN  ,VPTSIG  ,VPT  )
000301          CALL SPNRN1(VTOIN  ,VTOSIG  ,VTO  )
          C ---  CALCULATE COMPONENTS OF THE WIND VELOCITY
000304          VWINDX   =  VWIND * COS(THW)
000307          VWINDY   =  VWIND * SIN(THW)
          C ---  CALCULATE COMPONENTS OF THE PARACHUTE DRIFT VELOCITY
          C     VPTX     =  VPT * COS(THP)
          C     VPTY     =  VPT * SIN(THP)
          C     STH1     =  SIN(TH1)
          C     CTH1     =  COS(TH1)
```

```
000312          STH2    =  SIN(TH2)
000314          CTH2    =  COS(TH2)
000316          SPSI    =  SIN(PST)
000320          CPSI    =  COS(PST)
                C       SPH1    =  SIN(PH1)
                C       CPH1    =  COS(PH1)
000322          SPH2    =  SIN(PH2)
000324          CPH2    =  COS(PH2)
                C ---    NOZZLE VELOCITY FOR SRB CONING MOTION
                C       AMULT   =  W2 * STH2 * XLS
                C       R       =  SQRT(((XLF + XLS * CTH2) * STH1
                C     1         +  XLS * STH2 * CPH2 * CTH1) ** 2
                C     2         +  (XLS * STH2 * SPH2) ** 2 ) * W1
                C       ATEMP   =  AMULT * SPH2 * CTH1
                C ---    CALCULATE COMPONENTS OF THE SRB ROTATIONAL VELOCITY
                C       VPOX    =  - R * SPH1 - ATEMP * CPH1 - CPH2 * SPH1 * AMULT
                C       VPOY    =  R * CPH1 - ATEMP * SPH1 + AMULT * CPH2 * CPH1
                C       VPOZ    =  - AMULT * SPH2 * STH1
                C ---    NOZZLE VELOCITY FOR PLANAR MOTION IN WIND PLANE
000326          VP      =  XLS * TH2DOT
000332          VPOZ    =  VP * STH(TH2)
000333          VPOY    =  VP * COS(TH2) * COS(THW)
000341          VPOZ    =  VP * COS(TH2) * SIN(THW)
000347          STHWM   =  SIN(THWM)
000351          CTHWM   =  COS(THWM)
000353          STCUR   =  SIN(THCUR)
000355          CTCUR   =  COS(THCUR)
000360          ATEMP   =  VCURNT
000361          BTEMP   =  VWM * CPSI
                C ---    CALCULATE COMPONENTS OF THE WATER VELOCITY
000363          VWMX    =  ATEMP * CTCUR + BTEMP * CTHWM
000366          VWMY    =  ATEMP * STCUR + BTEMP * STHWM
000371          VWMZ    =  VWM * SPSI
                C ---    CALCULATE COMPONENTS OF THE IMPACT VELOCITY
000373          VIX     =  VWINDX + VPTX + VPOX - VWMX
000377          VIY     =  VWINDY + VPTY + VPOY - VWMY
000403          VIZ     =  VWINDZ + VPTZ + VPOZ - VWMZ - VTO
000410          VH      =  SQRT(VIX * VIX + VIY * VIY)
000417          A       =  STH1 * CTH2 + CTH1 * STH2 * CPH2
000422          B       =  STH2 * SPH2
000424          SLY     =  A * CPH1 - B * SPH1
000427          SLY     =  A * SPH1 + B * CPH1
000431          SLZ     =  STH2 * CPH2 * STH1 - CTH2 * CTH1
                C ---    CALCULATE IMPACT ANGLE
000435          THI     =  ATAN((VIX * SLX + VIY * SLY) / (-SLZ * VH ))
                C ---    TAKE INTO ACCOUNT VELOCITY DUE TO RETRO
000444          IF( DVRMEN .EQ. 0.0 )     GO TO 40
000446          CALL SENRN1( DVRMEN  ,DVRSIG  ,DVP  )
000450          THETAR  =  2. * THETAMR * (RANF(0) - .5)
000455          VH      =  VH - DVP * SIN(THI - THETAR)
000464          VIZ     =  VIZ - DVR * COS(THI - THETAR)
                C ---    CONVERT IMPACT PARAMETERS TO ENGLISH UNITS
000473          40      FVIZ    =  ABS(VIZ * FTMT)
000475          FVH     =  VH  * FTMT
000477          DTHI    =  THI * RAD
```

```
000501          CALL LOADS(KNTMC  ,IXX  )
000503    1011  FORMAT(1H1,5X,* TERMIAL DESIGN VELOCITY * ,F6.2,2X,*METERS/SEC*)
000507    1012  FORMAT(1H1,5X,* NUMBER OF LAUNCHES FOR EACH MONTH * ,//,
               1            5X,* JAN -- *,I4,5X,* FEB -- *,I4,5X,* MAR -- *,I4,
               2            5X,* APR -- *,I4,/,
               3            5X,* MAY -- *,I4,5X,* JUN -- *,I4,5X,* JUL -- *,I4,
               4            5X,* AUG -- *,I4,/,
               5            5X,* SEP -- *,I4,5X,* OCT -- *,I4,5X,* NOV -- *,I4,
               6            5X,* DEC -- *,I4)
000504    50    VRTICAL(KNTMC)    =  VIZ
000505          VHORIZN(KNTMC)    =  VH
000507          THIMPAC(KNTMC)    =  THI
000511          GO TO 20
000511          END
```

PROGRAM LENGTH INCLUDING I/O BUFFERS
020142

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES		
000012	L00013	1	000006		
000020	L00017	5	000011		
000052	L00055	10	000222		
000117	L00117	20	000511		
000223	L00173	25	000115	000116	
000155	L00145	35	000136		
000474	L00312	40	000446		
000504	L00317	50	NONE		
000700	000055	1001	000116		
000707	000064	1002	000126		

BLOCK NAMES AND LENGTHS

TITLE -	000074	DAMAG -	000007	STAT -	000030	NUMBER -	000001
CSTDAT -	000007	CNDTNS -	000016	MAXSLP -	013560		

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES			
015041	V00144	A	000417			
000000C07	000021	ACTPRES	000166	000173		
014765	V00070	AMULT	000032			
014766	V00071	ATEMP	000033	000360		
015042	V00145	B	000424			
015027	V00132	BTEMP	000367			
014713	000011	COST	000211	000220	000620	
014764	V00067	CPH1	000031	000425		
015021	V00124	CPH2	000330	000415		
015017	V00122	CPSI	000323	000362		
000720C07	000022	CRTPRES	000175	000202		
014667	000007	CSTVT	000055			
015026	V00131	CTCUR	000360	000364		
015024	V00127	CTHWM	000354	000365		
014762	V00065	CTH1	000030	000421	000433	
015015	V00120	CTH2	000317	000420	000432	
000002C06	V00156	DTHI	000501			
015047	V00152	DVR	000447	000462	000471	
014737	V00042	DVMEN	000445	000446	000600	
014740	V00043	DVRSTG	000447	000603		
014745	V00050	ETMT	000474			
000001C06	V00155	EVH	000500			
000000C06	V00154	EVIZ	000476			
014776	V00101	I	000062	000070	000076	000206
014775	V00100	IFAIL	000060			
000000C02	000013	IFAL	000072			

014724	V00027	IRANF	000006	000527			
00300C01	000012	ITITLE	NONE				
014723	V00026	IXX	000502	000524			
014772	V00075	KNTMC	000035	000061	000113	000253	000502
014773	V00076	KNTVTC	000035	000052	000111	000134	000204
			000217				
014653	A00006	MCN	000364	000131	000252		
014750	V00053	N	000012	000014			
00300004	V00024	NUMMC	000044	000114	000140	000142	000146
			000155	000162	000166	000171	000175
			000516				
014722	V00025	NUMVTC	000053	000056	000521		
00300005	A00015	PFC	000212				
014754	V00057	PH1	000024				
015006	V00111	PH2	000273	000323	000325		
015007	V00112	PSI	000277	000317	000321		
001051	A00001	PTHW	000047	000261	000556		
014746	V00051	RAD	000500				
015043	V00146	SLX	000430	000437			
015044	V00147	SLY	000433				
015045	V00150	SLZ	000435				
014763	V00066	SPH1	000030	000426			
015020	V00123	SPH2	000325	000423			
015016	V00121	SPSI	000321	000379			
00300C03	A00014	STAT	000102				
015025	V00130	STCUR	000356	000366			
015023	V00126	STHWM	000352	000370			
014761	V00064	STH1	000027	000420	000432		
015014	V00117	STH2	000315	000415	000423		
014701	A00010	TEP	000056				
015005	V00110	THCUR	000271	000354	000356		
00C013C06	A00020	THETA	NONE				
014736	V00041	THETAMP	000455	000575			
015050	V00153	THETAR	000456	000465			
015046	V00151	THI	000445	000456	000464	000477	000507
001073	A00003	THIMPAC	000137	000144	000511		
014755	V00060	THP	000024				
015003	V00106	THW	000255	000263	000271	000305	000310
			000342				
015004	V00107	THWM	000262	000350	000352		
001062	A00002	THW1	000047	000262	000561		
014753	V00056	TH1	000023				
014727	V00032	TH1TN	000542				
014777	V00102	TH2	000233	000241	000313	000315	000331
			000344				
015000	V00103	TH2DOT	000250	000327			
014730	V00036	TH2TN	000232	000242	000545		
014743	V00046	TWOPHI	000226	000240	000267	000276	
014734	V00037	VCRNT	000277	000567			
014735	V00040	VCRNTSI	000300	000577			
015010	V00113	VCURNT	000300	000361			
015040	V00143	VH	000416	000435	000463	000476	000506
00C010C06	A00017	VHOR	NONE				
005013	A00004	VHORIZN	000146	000153	000510		
015033	V00136	VTX	000401	000411	000436		

015034	V00137	VTY	000405	000440			
015035	V00140	VTZ	000410	000472	000474	000505	
015002	V00125	VX	000331	000333	000340	000346	
014767	V00072	VXOX	000033	000374			
014770	V00073	VXOY	000034	000342	000400		
014771	V00074	VXOZ	000034	000334	000350	000404	
014756	V00061	VXT	000025				
014731	V00034	VXTTN	000550				
014732	V00035	VXTSIG	000553				
014757	V00062	VXTX	000025	000374			
014760	V00063	VXTY	000026	000400			
015037	V00142	VXTZ	000404				
010733	000005	VRTICAL	000155	000164	000506		
015011	V00114	VY0	000303	000406			
014741	V00044	VYDIN	000112	000121	000124	000160	000302
014742	V00045	VYOSIG	000302	000613			
00D093C06	A00016	VVEL	NONE				
015001	V00104	VWIND	000254	000307	000312		
015012	V00115	VWINDX	000310	000373			
015013	V00116	VWINDY	000313	000377			
015036	V00141	VWINDZ	000403				
015002	V00105	VWM	000254	000362	000371		
015030	V00133	VWMX	000367	000376			
015031	V00134	VWMY	000372	000402			
015032	V00135	VWMZ	000375				
014751	V00054	W1	000022				
014725	V00030	W1TN	000534				
014752	V00055	W2	000023				
014726	V00031	W2IN	000246	000537			
014747	V00052	X	000011	000017	000050		
014733	V00036	XLP	000251	000564			
014744	V00047	XLS	000250	000327			
014774	V00077	XNC	000046	000253			
00764DC07	A00023	XNSAV	NONE				

START OF CONSTANTS
000623

START OF TEMPORARIES
000762

START OF INDIRECTS
001042

EXTERNAL REFERENCES

SYMBOL	REFERENCES						
GNTRY	000002						
INPUTN	000005	000040	000043	000110			
RANF	000010	000016	000224	000234	000266	000274	000452
TIME	000013						
BELT	000021						
WAVE	000051	000264					
COSTBLT	000057						
OUTPTC	000120	000122	000123	000130	000132	000133	

WRIT	000125						
HIST	000141	000150	000157	000170	000177		
PLOT	000145	000154	000165	000174	000203		
SIN	000231	000311	000314	000320	000324	000332	000343
	000355	000461					
COS	000245	000306	000316	000322	000326	000335	000337
	000353	000357	000470				
WIND	000255	000260					
SENSN1	000301	000304	000450				
SQRT	000414						
ATAN	000444						
LOADS	000503						
END	000513						

UNUSED COMPILER SPACE
000000

```
                SUBROUTINE WAVE(N  ,X  ,Y  ,VAL  ,TWM)
              C-------------------------------------------------------------------
              C     THIS ROUTINE CALCULATES THE WAVE DIRECTION
              C     N ------- IF N EQUALS 0 CALCULATE THE SLOPES FROM THE INPUT DATA
              C               IF N EQUALS 1 CALCULATE WIND DIRECTION
              C     X ------- ARRAY WITH PROBABILITY VALUES
              C     Y ------- ARRAY WITH WAVE DIRECTIONS
              C     VAL ----- DIRECTION OF WAVE
              C     TWM ----- DIRECTION OF WIND
              C-------------------------------------------------------------------
000007                DIMENSION  X(1)  ,Y(1)  ,SLOPE(8)
000007                IF(N .NE. 0)       GO TO 20
              C ---     COMPUTE SLOPES WHEN N = 0
000010                DO 11 I=1,8
000014                SLOPE(I)  =  (Y(I+1) - Y(I)) / (X(I+1) - X(I))
000020          10    CONTINUE
000021                RETURN
000021          20    Z     =  RANF(0)
000024                DO 31 I=1,8
000030                IF(Z .GT. X(I))     GO TO 30
000034                VAL  =  (Z - X(I-1)) * SLOPE(I-1) + Y(I-1)
000037                GO TO 40
000040          30    CONTINUE
000042                VAL  =  (Z - X(8)) * SLOPE(8) + Y(8)
000046          40    VAL  =  VAL + TWM + 6.283184
000050                VAL  =  AMOD(VAL  ,6.283184)
000053                RETURN
000054                END
```

SUBPROGRAM LENGTH
000106

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000022	L000023	20	000010
000041	L000035	30	000033
000047	L000046	40	000040

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES		
000104	V000007	I	000011	000037	000041
000074	C000001	SLOPE	000013		
000105	V000010	Z	000024	000031	000043

START OF CONSTANTS
000057

START OF TEMPORARIES
000062

START OF INDIRECTS
000070

EXTERNAL REFERENCES

SYMBOL	REFERENCES
RANF	000023
END	000056

UNUSED COMPILER SPACE
006700

```
                SUBROUTINE SLAP(XLOD  ,XPRES  ,IF  ,KNTMC  )
               C-----------------------------------------------------------------------
               C     THIS ROUTINE DETERMINES IF THE CASE HAS BEEN DAMAGE ON SLAP-DOWN
               C     XLOD --- VALUE COMPUTED FOR LOAD ON CASE IN SUBROUTINE LOADS
               C     XPRES -- VALUE COMPUTED FOR PRESSURE ON CASE IN SUBROUTINE LOADS
               C     IF ----- IF ON RETURN FROM THIS ROUTINE
               C              IF  =  0  NO DAMAGE TO CASE
               C              IF  =  1  2 - SEGMENT DAMAGE
               C              IF  =  2  SINKAGE
               C     KNTMC -- MONTE CARLO TRIAL BEING COMPUTED
               C-----------------------------------------------------------------------
000006               COMMON  /  MAXSLP  /  APRES(2000)  ,CPRES(2000)  ,XNS(2000)
000006               DIMENSION  PROB(10) ,XNC2(5) ,SSCAS2(50)
               C ---  STRENGTH FOR CASE - SLAPDOWN - HOOP MOMENT
000006               DATA PROB /  0.  ,.01  ,.05  ,.10  ,.20  ,.80  ,.90  ,.95  ,
                    1            .99  ,1.0  /
000006               DATA XNC2 /  0.  ,79000.  ,50000.  ,60000.  ,70000.  /
               C ---  HOOP MOMENT FOR BASELINE
000006               DATA SSCAS2 /  9600.  ,4*0.  ,10200.  ,4*0.  ,10700.  ,4*0.  ,
                    1              10950.  ,4*0.  ,11250.  ,4*0.  ,12500.  ,4*0.  ,
                    2              12800.  ,4*0.  ,13050.  ,4*0.  ,13500.  ,4*0.  ,
                    3              14100.  ,4*0.  /
000006               IF  =  0
               C ---  DO BIVARINT INTERPOLATION FOR CRITICAL PRESSURE
000006               Z   =  RANF(0)
000011               II  =  0
000011               JJ  =  0
000012               DO 10 J=1,10
000020               JJ  =  11 - J
000021               IF(PROB(JJ) .LE. Z)   GO TO 15
000025    10         CONTINUE
000027    15         IF(JJ .EQ. 10)   JJ  =  9
000032               DO 20 I=1,5
000036               II  =  6 - I
000037               IF(XNC2(II) .LE. XLOD)   GO TO 25
000043    20         CONTINUE
000045    25         IF(II .EQ. 5)   II  =  4
000052               LOC  =  II + 5 * (JJ-1)
000055               G3   =  SSCAS2(LOC+6)
000057               G2   =  SSCAS2(LOC+5)
000061               G1   =  SSCAS2(LOC+1)
000064               G0   =  SSCAS2(LOC)
000066               OVH  =  (Z - PROB(JJ)) / (PROB(JJ+1) - PROB(JJ))
000072               GAA  =  G0 + OVH * (G2 - G0)
000075               GBB  =  G1 + OVH * (G3 - G1)
000100               PCRIT  =  GAA + (XLOD - XNC2(II)) / (XNC2(II+1) - XNC2(II))
                    *         *  (GBB - GAA)
               C ---  SAVE LOAD, ACTUAL PRESSURE AND CRITICAL PRESSURE
000106               XNS(KNTMC)     =  XLOD
000107               APRES(KNTMC)   =  XPRES
000110               CPRES(KNTMC)   =  PCRIT
000112               IF(XPRES .LT. PCRIT)     RETURN
000114               IF  =  1
000115               IF((XPRES / PCRIT) .LT. 1.2)    RETURN
000121               IF  =  2
```

```
000122          RETURN
000123          END
```

SUBPROGRAM LENGTH
000274

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000030	L00026	15	000025
000046	L00042	25	000043

BLOCK NAMES AND LENGTHS
MAXSLP - 013560

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
000000C01	A00001	APRES	000111				
003720C01	A00002	CPRES	000112				
000270	V00025	DVH	000074				
000271	V00026	GAA	000076				
000272	V00027	GBB	000101				
000267	V00024	G0	000070				
000266	V00023	G1	000065	000076			
000265	V00022	G2	000062	000072			
000264	V00021	G3	000060	000075			
000262	V00017	I	000034	000036			
000257	V00014	II	000012	000040	000046	000053	000102
000261	V00016	J	000016	000027			
000260	V00015	JJ	000012	000022	000030	000052	
000263	V00020	LOC	000055	000057	000062	000064	
000273	V00030	PCPIT	100107	000111	000116		
000155	A00004	PROB	000023	000067			
000174	A00006	SSCAS2	000066				
000167	A00005	XNC2	000041	000103			
007640C01	A00003	XNS	000110				
000256	V00013	Z	000011	000020	000071		

START OF CONSTANTS
000126

START OF TEMPORARIES
000131

START OF INDIRECTS
000153

EXTERNAL REFERENCES

SYMBOL	REFERENCES
RANF	000010
END	000125

UNUSED COMPILER SPACE
006300

```
      SUBROUTINE STREN(TABL  ,VALUE  ,IF  )
C-----------------------------------------------------------------------
C     THIS ROUTINE DETERMINES IF DAMAGE HAS OCCURED TO A PARTICULAR PART
C     TABL --- TABLE FOR INTERPOLATION OF LOAD OR PRESSURE STRENGTH
C     VALUE -- ACTUAL VALUE FOR LOAD OR PRESSURE GENERATED IN LOADS
C     IF ----- FLAG FOR INDICATION OF DAMAGE
C              IF  =  0  NO DAMAGE
C              IF  =  1  DAMAGE
C-----------------------------------------------------------------------
000005        DIMENSION  TABL(11)  ,PROB(10)
000005        DATA  PROB /  0.  ,.01  ,.05  ,.1  ,.2  ,.8  ,.9  ,.95  ,.99  ,
     1                1.0  /
000005        IF  =  0
000005        Z  =  RANF(0)
000010        DO 10 I=1,10
000013        IF(Z .GT. PROB(I))  GO TO 10
000017        VAL  =  (Z - PROB(I-1)) * ((TABL(I) - TABL(I-1)) / (PROB(I) -
     -              PROB(I-1))) + TABL(I-1)
000026        GO TO 15
000026   10   CONTINUE
000030   15   IF(VALUE .GT. VAL)  IF  =  1
000034        RETURN
000035        END
```

SUBPROGRAM LENGTH
000076

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000027	L00022	10	000016
000031	L00024	15	000026

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES		
000074	V00006	J	000013	000027	
000061	E00001	PROB	NONE		
000075	V00007	VAL	000026	000031	
000073	V00005	Z	000010	000014	000023

START OF CONSTANTS
000040

START OF TEMPORARIES
000042

START OF INDIRECTS
000054

EXTERNAL REFERENCES

SYMBOL	REFERENCES
PANF	000007
END	000037

UNUSED COMPILER SPACE
007000

```
      SUBROUTINE HIST(VALUE  ,KOUNT  ,JTITLE  )
C-----------------------------------------------------------------------
C     THIS ROUTINE GENERATES A HISTOGRAM FOR OUTPUT.  IT USES A 5 PER CENT
C     OF THE TOTAL NUMBER OF MONTE CARLO TRAILS AS ITS BASE.
C     VALUE --- ARRAY WHICH CONTAINS THE DATA FROM WHICH THE HISTGRAM
C               IS TO BE GENERATED FROM, ON RETURN FROM THIS ROUTINE THE
C               ARRAY VALUE HAS BEEN SORTED INTO ASCENDING ORDER
C     KOUNT --- TOTAL NUMBER OF MONTE CARLO TRAILS
C     JTITLE -- POINTER FOR PRINT OUT OF CORRECT TITLE                  .2
C-----------------------------------------------------------------------
000005       COMMON   / TITLE /  NN(60)
000005       DIMENSION  VALUE(1)  ,SUM(20)
000005       DATA  NN     /
            1              10H VERTICAL   ,10HIMPACT VEL  ,10HOCITY (M/S  ,
            2              10H) FOR STEP  ,10HS OF .05 P  ,10HROBABILITY  ,
            3              10HHORIZONTAL  ,10H IMPACT VE  ,10HLOCITY(M/S  ,
            4              10H) FOR STEP  ,10HS OF .05 P  ,10HROBABILITY  ,
            5              10HIMPACT ANG  ,10HLE (RADIAN  ,10HS)          ,
            6              10H  FOR STEP  ,10HS OF .05 P  ,10HROBABILITY  ,
            7              10HLOAD ON CA  ,10HSE (LBS/IN  ,10H)           ,
            8              10H  FOR STEP  ,10HS OF .05 P  ,10HROBABILITY  ,
            9              10HHOOP MOMEN  ,10HT ON CASE   ,10H(IN-LB/IN)  ,
            1              10H) FOR STEP  ,10HS OF .05 P  ,10HROBABILITY  ,
            2              10HHOOP MOMEN  ,10HT CAPABILI  ,10HTY          ,
            3              10H) FOR STEP  ,10HS OF .05 P  ,10HROBABILITY  /
000005       IOUTS   =  (JTITLE -1) * 6 + 1
000007       IOUTP   =   IOUTS + 5
000011       YMEAN   =  0.
000011       SIGMA   =  0.
000012       IHALF   =  KOUNT / 2 + .5
000016       NNTNE   =  KOUNT * .99
000021       IF(JTITLE .NE. 1)    GO TO 2
C ---  TAKE THE ABSOLUTE VALUE OF VERTICAL VELOCITY DUE TO SIGN CONVENTION .
000023       DO 1 I=1,KOUNT
000026       VALUE(I)  =  ABS(VALUE(I))
000027  1    CONTINUE
000030  2    DO 5 KK=1,20
000035       SUM(KK)  =  0.
000036  5    CONTINUE
000037       CALL SORX(VALUE  ,KOUNT)
000040       INC  =  KOUNT * .05
000045       DO 11 I=1,20
000046       ISTR  =  (I-1) * INC + 1
000051       ISTP  =  I * INC
000052       IF(ISTP .GT. KOUNT)    ISTP  =  KOUNT
000056       DO 11 J=ISTR,ISTP
000064       SUM(I)  =  SUM(I) + VALUE(J)
000065  10   CONTINUE
000073       DO 21 I=1,20
000077       SUM(I)  =  SUM(I) / INC
000101  20   CONTINUE
000102       DO 30 I=1,KOUNT
000110       XMEAN  =  XMEAN + VALUE(I)
000111  30   CONTINUE
000112       XMEAN  =  XMEAN / KOUNT
```

```
000114          DO 40 I=1,KOUNT
000122          SIGMA  =  SIGMA + (VALUE(I) - XMEAN) ** 2
000124    40    CONTINUE
000125          SIGMA  =  SQRT(SIGMA / KOUNT)
000134          WRITE(6,1005)  (NN(I),I=IOUTS,IOUTP)
000145          IF(JTITLE .LT. 4)      GO TO 25
000151          WRITE(6,1003)  (SUM(I),I=1,20)
000157          WRITE(6,1004)  VALUE(1)  ,VALUE(KOUNT)
000174          WRITE(6,1007)  XMEAN  ,SIGMA  ,VALUE(IHALF) , VALUE(NNINE)
000216          RETURN
000217    25    WRITE(6,1001)  (SUM(I),I=1,20)
000225          WRITE(6,1002)  VALUE(1)  ,VALUE(KOUNT)
000242          WRITE(6,1008)  XMEAN  ,SIGMA  ,VALUE(IHALF) ,VALUE(NNINE)
000264    1000  FORMAT(1HO,5X,6A10)
000266    1001  FORMAT(1HO,4(5X,F10.4))
000266    1002  FORMAT(1HO,5X,15H MINIMUM VALUE ,2X,F10.4,/,
                1           6X,15H MAXIMUM VALUE ,2X,F10.4)
000266    1003  FORMAT(1HO,4(5X,F10.0))
000266    1004  FORMAT(1HO,5X,15H MINIMUM VALUE ,2X,F10.0,/,
                1           6X,15H MAXIMUM VALUE ,2X,F10.0)
000266    1005  FORMAT(1H1,5X,6A10)
000266    1007  FORMAT(1HO,5X,7H  MEAN ,10X,F10.0,/,
                1           6X,7H SIGMA ,10X,F10.0,/,
                2           6X,7HMEDIAN ,10X,F10.0,/,
                3           6X,20HNINETY NINE PERCENT ,F10.0)
000266    1008  FORMAT(1HO,5X,7H  MEAN ,10X,F10.4,/,
                1           6X,7H SIGMA ,10X,F10.4,/,
                2           6X,7HMEDIAN ,10X,F10.4,/,
                3           6X,20HNINETY NINE PERCENT ,F10.4)
000266          RETURN
000267          END
```

SUBPROGRAM LENGTH
000507

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000031	L000026	2	000023
000220	L000127	25	000151
000277	0000005	1000	NONE
000302	0000010	1001	000220
000305	0000013	1002	000230
000321	0000027	1003	000152
000324	0000032	1004	000162
000340	0000046	1005	000136
000343	0000051	1007	000177
000374	0000102	1008	000245

BLOCK NAMES AND LENGTHS
TITLE - 000074

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
000501	V000014	I	000024	000046	000061	000071	000074
			000116				
000477	V000012	IHALF	000017	000207	000255		
000503	V000016	INC	000045	000047	000077		
000474	V000007	IOUTP	000011	000142			
000473	V000006	ICUTS	000010	000141			
000505	V000020	ISTP	000053	000056	000063		
000504	V000017	ISTP	000051	000057			
000506	V000021	J	000060				
000502	V000015	KK	000032				
000000C01	8000001	NN	NONE				
000500	V000013	NNINE	000021	000213	000261		
000476	V000011	SIGMA	000013	000121	000127	000134	000204
000447	A000002	SUM	000034	000076	000155	000223	
000475	V000010	XMEAN	000012	000110	000113	000121	000202

START OF CONSTANTS
000272

START OF TEMPORARIES
000425

START OF INDIRECTS
000437

EXTERNAL REFERENCES

SYMBOL	REFERENCES

```
SQRX        000040
SQRT        000133
OUTPTC      000140    000144    000145    000154    000156    000157    000164
            000173    000174    000201    000203    000205    000211    000215
            000222    000224    000225    000232    000235    000241    000242
            000251    000253    000257    000263    000264
END         000271

UNUSED COMPILER SPACE
005400
```

```
000007          SUBROUTINE PLOT(IT  ,KOUNT  ,XSTRT  ,XINC  ,VALUE  )
                C-------------------------------------------------------------------
                C     PLOTS THE PROBABILITY DENSITY FUNCTION FOR INPUT ARRAY
                C     IT ------ POINTER FOR TITLE
                C     KOUNT --- TOTAL NUMBER OF MONTE CARLO TRAILS
                C     XSTR ---- INITAL VALUE ON X-AXIS
                C     XINC ---- INCREMENT FOR MAJOR GRIDS ON X-AXIS
                C     VALUE --- ARRAY TO BE PLOTTED
                C-------------------------------------------------------------------
000007          DIMENSION  VALUE(1)
000007          COMMON  / TITLE /   NN(60)
000007          CALL SPLT(XSTRT  ,XINC  ,1H   ,NN(IT)  ,0.  ,0  ,0.  ,1. ,1H   )
000021          DO 10  I=1,KOUNT
000026          XX  =  I
000027          Y   =  XX / KOUNT
000031          CALL FPLT(VALUE(I)  ,Y  )
000036    10    CONTINUE
000041          CALL EPLT(0)
000042          RETURN
000043          END
```

SUBPROGRAM LENGTH
000066

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

BLOCK NAMES AND LENGTHS
TITLE - 000074

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES	
000063	V00007	I	000026	000037
000000C01	000001	NA	NONE	
000064	V00010	XX	000030	
000065	V00011	Y	000031	000032

START OF CONSTANTS
000046

START OF TEMPORARIES
000060

START OF INDIRECTS
000062

EXTERNAL REFERENCES

SYMBOL	REFERENCES	
SPLT	000014	000021
FPLT	000033	
FPLT	000042	
END	000045	

UNUSED COMPILER SPACE
007000

```
      SUBROUTINE WINC(MNTH  ,XNC  ,NTRIAL  ,VWIND  ,VWM  ,THW  ,Z  )
C-----------------------------------------------------------------------
C     THIS ROUTINE COMPUTES THE WIND PARAMETER BY USING PRE-CALCULATED
C     COVARIANT COEFFICIENTS FOR EACH MONTH
C     MNTH --- ARRAY WHICH STORES THE NUMBER OF LAUNCHES FOR EACH MONTH
C              (EQUAL NUMBER OF LAUNCHES PER MONTH)
C     XNC  --- EQUAL TO THE NUMBER OF LAUNCHES PER MONTH
C     NTRIAL - MONTE CARLO TRIAL BEING PROCESSED
C     VWIND -- VELOCITY OF THE WIND AT THE CANOPY HEIGHT
C     VWM ---- WAVE VELOCITY
C     THW ---- WIND DIRECTION
C     Z ------ HEIGHT OF THE CANOPY
C-----------------------------------------------------------------------
000011        DIMENSION  COVAR(72)  ,MNTH(1)
000011        DATA  COVAR  /
C ---  DATA FOR JANUARAY
     1          3.03  ,0.91  ,7.003212934  ,-.3083968188  ,
     2          .3353012103  ,6.441278838  ,
C ---  DATA FOR FEBRUARY
     1          3.65  ,2.35  ,7.106562509  ,1.484711855  ,
     2         -1.668550755  ,6.323570064  ,
C ---  DATA FOR MARCH
     1          3.22  ,1.70  ,6.859879407  ,-.3727660442  ,
     2          .4188135529  ,6.105652724  ,
C ---  DATA FOR APRIL
     1          0.89  ,1.20  ,6.713333663  ,.5989583722  ,
     2         -.7519572687  ,5.347388170  ,
C ---  DATA FOR MAY
     1          -.71  ,0.96  ,5.096806095  ,-1.216621401  ,
     2          1.565050691  ,3.962097464  ,
C ---  DATA FOR JUNE
     1          0.22  ,1.83  ,4.793859691  ,-1.311414985  ,
     2          1.885933143  ,3.333490087  /
000011        DATA  (COVAR(I),I=37,72)  /
C ---  DATA FOR JULY
     1          0.94  ,2.84  ,4.488889924  ,.09983610795  ,
     2         -.1334843370  ,3.357347453  ,
C ---  DATA FOR AUGUST
     1          0.19  ,1.89  ,4.342658383  ,-.8232363967  ,
     2          1.088517267  ,3.284315780  ,
C ---  DATA FOR SEPTEMBER
     1         -2.06  ,0.40  ,5.249204134  ,-2.627309642  ,
     2          3.570722742  ,3.862323016  ,
C ---  DATA FOR OCTOBER
     1         -1.56  ,-1.42  ,5.464846616  ,-2.197168964  ,
     2          2.925924200  ,4.103726057  ,
C ---  DATA FOR NOVEMBER
     1         -0.32  ,-0.78  ,6.549793840  ,-1.672662742  ,
     2          2.246047792  ,4.877721732  ,
C ---  DATA FOR DECEMBER
     1          1.11  ,0.21  ,6.766937664  ,-.5591552970  ,
     2          .6577588484  ,5.752517125  /
000011        DO 10 I=1,11
000012        IF(NTRIAL .GT. (I * XNC + .5))    GO TO 10
000020        MONTH  =  I
```

```
000021          GO TO 15
000021    10    CONTINUE
000023          MONTH  =  12
000024    15    MNTH(MONTH)  =  MNTH(MONTH) + 1
000026          KNT  =  (MONTH - 1) * 6 + 1
000032          CALL SPNRN1(0.  ,1.  ,P1)
000034          CALL SPNRN1(0.  ,1.  ,P2)
000037          VU  =  COVAR(KNT) + COVAR(KNT+2) * P1 + COVAR(KNT+3) * P2
000044          VV  =  COVAR(KNT+1) + COVAR(KNT+4) * P1 + COVAR(KNT+5) * P2
      C ---  COMPUTE 1 KILOMETER WIND
000051          V1KM  =  SQRT(VU * VU + VV * VV  )
000055          THW  =  ATAN2(VV , VU  )
      C ---  EXTRAPOLATE 1 KILOMETER WIND DOWN TO CONOPY HEIGHT
000067          IF(V1KM .GT. 14.0)    GO TO 20
000073          P  =  0.16 * ((V1KM / 14.0) ** 1.9)
000077          GO TO 25
000077    20    P  =  0.21 * ((V1KM / 21.0) ** .67)
000105    25    IF(Z .GT. 150.0)   GO TO 30
000111          VWIND  =  V1KM * ((Z / 150.) ** P)
000115          GO TO 35
000115    30    VWIND  =  V1KM
000116    35    VREF  =  V1KM * (0.13 ** P)
000123          CALL SPNRN1(0.  ,VREF * 0.0645  ,VKM  )
000127          H13  =  0.0214 * VREF * VREF
000131          RETURN
000132          END
```

SUBPROGRAM LENGTH
000315

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000022	L00023	10	000017
000025	L00026	15	000021
000100	L00050	20	000072
000106	L00052	25	000077
000116	L00060	30	000110
000117	L00061	35	000115

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
000172	A00001	COVAR	000042				
000314	V00023	F13	000131				
000302	V00011	I	000012	000022			
000304	V00013	KNT	000032	000040	000045		
000303	V00012	MONTH	000021	000024	000025	000027	
000312	V00021	P	000077	000105	000112	000117	
000305	V00014	P1	000033	000041			
000306	V00015	P2	000036	000043			
000313	V00022	VREF	000123	000130			
000307	V00016	VU	000045	000062			
000310	V00017	VV	000051	000061			
000311	V00020	V1KM	000062	000067	000100	000114	000116
000000	L00012	Z	000106				

START OF CONSTANTS
000135

START OF TEMPORARIES
000157

START OF INDIRECTS
000172

EXTERNAL REFERENCES

SYMBOL	REFERENCES			
SENSN1	000034	000037	000127	
SQRT	000055			
ATAN2	000063			
RRAREX	000075	000103	000113	000121
END	000134			

UNUSED COMPILER SPACE

006200

```
                SUBROUTINE SORX(A,JJ)
000004          INTEGER A(1), T, TT, IU(16), IL(16)
000004          M = 1
000004          I = 1
000005          J = JJ
000007    5     IF(I.GE.J) GO TO 70
000012    10    K = I
000013          IJ = (J+I)/2
000015          T = A(IJ)
000017          IF(A(I).LE.T) GO TO 20
000023          A(IJ) = A(I)
000024          A(I)  = T
000025          T     = A(IJ)
000026    20    L     = J
000027          IF(A(J).GE.T) GO TO 40
000034          A(IJ) = A(J)
000034          A(J)  = T
000035          T     = A(IJ)
000036          IF(A(I).LE.T) GO TO 40
000043          A(IJ) = A(I)
000043          A(I)  = T
000044          T     = A(IJ)
000045          GO TO 40
000047    30    A(L) = A(K)
000051          A(K) = TT
000052    40    L = L - 1
000054          IF(A(L).GT.T) GO TO 40
000060          TT = A(L)
000061    50    K = K + 1
000063          IF(A(K).LT.T) GO TO 50
000066          IF(K .LE. L)  GO TO 30
000070          IF(L-I.LE.J-K)  GO TO 60
000073          IL(M) = I
000074          IU(M) = L
000075          I     = K
000076          M     = M + 1
000077          GO TO 80
000077    60    IL(M) = K
000101          IU(M) = J
000103          J     = L
000104          M     = M + 1
000105          GO TO 80
000105    70    M     = M - 1
000107          IF(M .EQ. 0) RETURN
000111          I     = IL(M)
000112          J     = IU(M)
000114    80    IF(J-I .GE. 11) GO TO 10
000117          IF(I. EQ. 1) GO TO 5
000121          I     = I - 1
000121    90    I     = I + 1
000123          IF(I. EQ. J) GO TO 70
000124          T     = A(I+1)
000125          IF(A(I) .LE.T) GO TO 90
000130          K     = I
000131    100   A(K+1)= A(K)
```

```
000134          K      = K - 1
000134          IF(T .LT. A(K)) GO TO 100
000137          A(K+1) = T
000140          GO TO 90
000141          END
```

SUBPROGRAM LENGTH
000?27

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES			
CC0010	L000 11	5	000121			
?00013	L000 13	10	000117			
000027	L000 23	20	000022			
000047	L000 37	30	000067	000070		
000053	L000 41	40	000032	000041	000046	000057
000062	L000 46	50	000066			
000100	L000 62	60	000072	000078		
000106	L000 67	70	000011	000012	000124	
000115	L000 75	80	000077	000105		
000122	L000 02	90	000130	000141		
000132	L00111	100	000137			

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
000222	V000 10	I	000006	000010	000013	000036	000070
			000115	000122			
000225	V000 13	IJ	000016	000033	000042		
000201	8000 02	TL	000112				
000161	8000 01	IU	000113				
000223	V000 11	J	000007	000010	000014	000027	000071
			000114	000115	000123		
000224	V000 12	K	000014	000047	000062	000101	000131
000226	V000 14	L	000030	000050	000053	000066	000103
000221	V000 07	M	000005	000073	000100	000106	000111
000157	V000 03	T	000020	000026	000031	000037	000045
			000064	000126	000136		
000160	V000 04	TT	000052	000061			

START OF CONSTANTS
000144

START OF TEMPORARIES
000145

START OF INDIRECTS
000151

EXTERNAL REFERENCES

SYMBOL	REFERENCES
END	000143

UNUSED COMPILER SPACE
006500

```
      SUBROUTINE LOADS(KNTMC  ,IXTEN  )
C-----------------------------------------------------------------------
C     THIS ROUTINE COMPUTES THE LOADS AND/OR PRESSURE ON THE VARIOUS
C     COMPONENTS OF THE SRB AND CALLS STREN WHICH DETERMINES IF THE
C     COMPONENTS HAVE FAILED
C     KNTMC --- MONTE CARLO TRIAL BEING PROCESSED
C     IXTEN --- FLAG FOR INDICATION OF NOZZLE EXTENSION
C               IF IXTEN  =  0  NO NOZZLE EXTENSION
C               IF IXTEN  #  0  HAVE NOZZLE EXTENSION
C-----------------------------------------------------------------------
000004        DIMENSION  CAS1L(45)  ,CAS2L(45)  ,CAS2P(45)  ,CAS3P(45)  ,
     1                   FWSP(45)   ,XNOZL(45)  ,XNOZLX(45) ,AFOL(45)   ,
     2                   AFOLX(45)  ,AFSP(45)   ,AFSPX(45)  ,SSCAS1(10) ,
     3                   SSCAS3(10) ,SSNOZLX(10),SSAFOL(10) ,SSAFSP(10) ,
     3                   SSNOZL(10) ,SSAFOLX(10),SSAFSPX(10),
     4                   SSFWSP(10) ,TH1(3)
000004        COMMON / DAMAG / IFAL(7)
000004        COMMON / CNOTNS /  VV  ,VH  ,TTH  ,VVEL(5)  ,VHOR(3)  ,THETA(3)
000004        COMMON / STAT /  STAT(24)
000004        DATA  TH1  /  -10.  ,0.  ,10.  /
C ---  CASE LOADS FOR PEAK ACCELERATION        8/21/73
000004        DATA CAS1L /  3500.  ,3000.  ,3500.  ,4100.  ,3800.  ,3600.  ,
     1                   4800.  ,4300.  ,3700.  ,3500.  ,2100.  ,3500.  ,
     2                   6600.  ,5900.  ,5200.  ,10400., 10100. ,9800.  ,
     3                    5500. , 3500. , 5500. ,10100. , 9000. ,7900.  ,
     4                   14800. ,13500. ,12400. , 8400. , 5200. , 8400. ,
     5                   14700. ,12900. ,11100. ,20800. ,19200. ,17600. ,
     6                   14200. , 8700. ,14200. ,24600. ,22000. ,20000. ,
     7                   35000. ,32500. ,30000. /
C ---  CASE LOAD FOR PEAK SLAPDOWN-+10 DEG TO -10 DEG (45 VALUES)
000004        DATA CAS2L / 45*0./
C        DUMMY CASE LOAD- STRENGTH IS NOW UNIVARIATE- PUT IN AT L=0.
C ---  CASE HOOP MOMENT    FOR PEAK SLAPDOWN-          8/21/73
000004        DATA CAS2P /  3*5300.,8000.,7300.,5800.,14500.,11500.,8500.,
     1                   3*5300.,8000.,7300.,5800.,14500.,11500.,8500.,
     2                   3*5300.,8000.,7300.,5800.,14500.,11500.,8500.,
     3                   3*5300.,8000.,7300.,5800.,14500.,11500.,8500.,
     4                   3*5300.,8000.,7300.,5800.,14500.,11500.,8500./
C ---  CASE PRESSURE FOR MAX SUBMERGENCE        8/21/73
000004        DATA CAS3P / 10.5  ,11.0  ,10.5  , 8.5  , 9.0  , 9.6  , 3.0  ,
     1                    4.0  , 5.0  ,12.0  ,12.6  ,12.0  , 9.5  ,10.1  ,
     2                   10.8  , 3.6  , 4.7  , 5.9  ,14.0  ,15.0  ,14.0  ,
     3                   10.7  ,11.7  ,12.3  , 4.3  , 5.6  , 6.9  ,16.5  ,
     4                   18.3  ,16.5  ,12.0  ,13.5  ,14.0  , 5.0  , 6.5, 8.,
     5                     21. ,26.   ,21.   ,14.   ,16.   ,17.   ,6.   ,8.,
     6                     10. /
C ---  NOZZLE EXTENSION,JOINT WITH NOZZLE EXTENSION       8/21/73
000004        DATA XNOZLX/3900.,3000.,3900.,4800.,4200.,3800.,5800.,4900.,
     1              4200.,
     2     6900.,4500.,6900.,6900.,5900.,5300.,9000.,7400.,5700.,
     3    10300.,6700.,10300.,9800.,8200.,7000.,13300.,10600.,7400.,
     4    15000.,9000.,15000.,13100.,11000.,9100.,18800.,14000.,9300.,
     5     25.E3, 13.E3, 25.E3, 2.E4, 16.E3, 13.E3, 32.E3, 21.E3, 14.E3/
C ---  NOZZLE THROAT LOAD -NO NOZZLE EXTENSION        8/21/73
000004        DATA XNOZL/1700.,1400.,1700.,2200.,2000.,1700.,2900.,2600.,2300.,
```

```
     1          2800.,1910.,2800.,3000.,2600.,2000.,3900.,3300.,2700.,
     2          4300.,2800.,4300.,4300.,3500.,2700.,5100.,4300.,3400.,
     3          6100.,3800.,6100.,5700.,4600.,3500.,6500.,5300.,4200.,
     4          9500.,5800.,9500.,8500.,6800.,5000.,9500.,7500.,5900./
C --- AFT DOME LOAD WITH NOZZLE EXTENSION                8/21/73
000004       DATA AFDLX /1.E4,5.E3,1.E4,21.E3,16200.,7800.,31200.,22.E3,12400.,
     1    19000.,7300.,19000.,30000.,22500.,11800.,42200.,30200.,18000.,
     2   31500.,11000.,31500.,43000.,31000.,16200.,57000.,40500.,26700.,
     3  45100.,15000.,45100.,59000.,41000.,22000.,75000.,53000.,33000.,
     4  73100.,23000.,73000.,82000.,58.E3,32.E3,1.E5,73.E3,47.E3/
C --- AFT DOME LOAD -NO NOZZLE EXTENSION          8/21/73
C      DATA AFDL/1700.,1400.,1700.,2200.,2000.,1700.,2900.,2600.,2300.,
C     1          2800.,1900.,2800.,3000.,2600.,2000.,3900.,3300.,2700.,
C     2          4300.,2800.,4300.,4300.,3500.,2700.,5100.,4300.,3400.,
C     3          6100.,3800.,6100.,5700.,4600.,3500.,6500.,5300.,4200.,
C     4          9500.,5800.,9500.,8500.,6800.,5000.,9500.,7500.,5900./
C --- AFT DOME  COLLAPSE PRESSURE  -NO NOZZLE EXTENSION   8/21
000004       DATA AFDL/57.,59.,57.,50.,52.,55.,45.,47.,49.,  78.,81.,78.,68.,
     1   71.,75.,61.,64.,66.,  109.,114.,109.,94.,98.,104.,84.,88.,91.,
     2    142.,161.,142.,125.,132.,142.,110.,117.,122.,
     3    220.,260.,220.,183.,195.,207.,155.,165.,175./
C --- AFT SKIRT COLLAPSE PRESSURE  -NO NOZZLE EXTENSION   8/21
000004       DATA AFSP/3*0.,45.,35.,12.,60.,50.,42.,
     1          3*0.,35.,23., 0.,53.,40.,29.,
     2          3*0.,26.,12., 0.,47.,30.,17.,
     3          3*0.,21., 0., 0.,40.,20., 5.,
     4          3*0., 6., 0., 0.,30.,10., 0./
C --- AFT SKIRT COLLAPSE PRESSURE  -WITH NOZZLE EXTENSION   8/21/73
000004       DATA AFSPX/3*0.,45.,35.,12.,60.,50.,42.,
     1          3*0.,35.,23., 0.,53.,40.,29.,
     2          3*0.,26.,12., 0.,47.,30.,17.,
     3          3*0.,21., 0., 0.,40.,20., 5.,
     4          3*0., 6., 0., 0.,30.,10., 0./
C ---FORWARD SKIRT PRESSURE - PEAK SLAPDOWN          8/21/73
000004       DATA FWSP  /     49.,43.,49.,60.,53.,51.,112.,90.,72.,
     1                    48.,43.,48.,59.,52.,50.,110.,88.,66.,
     2                    47.,43.,47.,58.,52.,50.,108.,85.,61.,
     3                    47.,43.,47.,57.,51.,49.,106.,83.,55.,
     4                    47.,43.,47.,58.,52.,50.,104.,80.,47./
C --- STRENGTH FOR CASE - PEAK ACCEL - LOAD          8/30/73
000004       DATA SSCAS1 /27.3E3,3.E4,32.7E3,34.2E3,36.E3,42.3E3,44.1E3,
     1              45.6E3,48.3E3,51.E3/
C --- STRENGTH FOR CASE - MAX SUBMER - PRESSURE          8/29/73
000004       DATA SSCAS3 /20.5,22.5,24.5,25.7,27.,31.7,33.1,34.1,36.2,38.2/
C --- NOZZLE THROAT STRENGTH - W/O EXT    BASELINE      8/30
000004       DATA SSNOZL /5460.,6000.,6540.,6840.,7200.,8460.,8820.,9120.,
     1              9660.,10200./
C --- NOZZLE THROAT STRENGTH - WITH EXT    BASELINE   8/30
000004       DATA SSNOZLX/5460.,6000.,6540.,6840.,7200.,8460.,8820.,9120.,
     1              9660.,10200./
C --- STRENGTH FOR AFT DOME -COLLAPS PRES- BASELINE W/O EXT. 8/30/73
000004       DATA SSAFDL /45.5,50.,54.5,57.,60.,70.5,73.5,76.,80.4,85./
C --- STRENGTH FOR AFT DOME -LOAD WITH EXT  - BASELINE     8/30
000004       DATA SSAFDLX/13.7E3,15.E3,16.3E3,17.1E3,18.E3,21.1E3,22.1E3,
     1         22.9E3,24.2E3,25.5E3/
```

```
      C ---  STRENGTH FOR AFT SKIRT - COLLAPSE PRESS-BASELINE  W/O EXT.8/30
000004      DATA SSAFSP /43.7,48.,52.4,54.7,57.6,67.7,70.6,73.,77.3,81.7/
      C ---  STRENGTH FOR AFT SKIRT - COLLAPSE PRES-BASELINE  WITH EXT  8/30
000004      DATA SSAFSPX/43.7,48.,52.4,54.7,57.6,67.7,70.6,73.,77.3,81.7/
      C ---  STRENGTH FOR FWD SKIRT - PRESSURE   BASELINE       8/30
000004      DATA SSFWSP /10.9,12.,13.1,13.7,14.4,16.9,17.65,18.2,19.3,20.4/
      C
      C ---  FIRST CHECK MAX SLAPDOWN BECAUSE ONLY IT CAN CAUSE SINKAGE
      C
000004      IFLAG    =  0
000005      CALL TRIVAR(CAS2L  ,XLOD  ,0  )
000007      CALL TRIVAR(CAS2P  ,XPRES  ,1  )
000012      STAT(1)  =  STAT(1) + XLOD
000014      STAT(2)  =  AMIN1(STAT(2)  ,XLOD  )
000017      STAT(3)  =  AMAX1(STAT(3)  ,XLOD  )
000022      STAT(4)  =  STAT(4) + XPRES
000024      STAT(5)  =  AMIN1(STAT(5)  ,XPRES  )
000026      STAT(6)  =  AMAX1(STAT(6)  ,XPRES  )
000031      CALL SLAP (XLOD  ,XPRES  ,IFAIL  ,KNTMC  )
000036      IF(IFAIL .NE. 2)  GO TO 10
000042      IFAL(2)  =  IFAL(2) + 1
000043      RETURN
      C ---  CASE LOAD FOR PEAK ACCELERATION
000044   10 CALL TRIVAR(CAS1L  ,XLOD  ,1  )
000047      STAT(7)  =  STAT(7) + XLOD
000051      STAT(8)  =  AMIN1(STAT(8)  ,XLOD  )
000054      STAT(9)  =  AMAX1(STAT(9)  ,XLOD  )
000057      CALL STREN(SSCAS1  ,XLOD  ,KFAIL  )
      C ---  CASE PRESSURE FOR MAX SUBMERGENCE
000063   15 CALL TRIVAR(CAS3P  ,XPRES  ,1  )
000066      STAT(10)  =  STAT(10) + XPRES
000070      STAT(11)  =  AMIN1(STAT(11)  ,XPRES  )
000073      STAT(12)  =  AMAX1(STAT(12)  ,XPRES  )
000076      CALL STREN(SSCAS3  ,XPRES  ,JFAIL  )
000100      IF(IFAIL .NE. 1 .AND. KFAIL .NE. 1 .AND. JFAIL .NE. 1)  GO TO 20
000113      IFAL(3)  =  IFAL(3) + 1
000114      IFLAG    =  1
      C ---  FORWARD SKIRT PRESSURE
000115   20 CALL TRIVAR(FWSP  ,XPRES  ,1  )
000120      STAT(13)  =  STAT(13) + XPRES
000122      STAT(14)  =  AMIN1(STAT(14)  ,XPRES  )
000125      STAT(15)  =  AMAX1(STAT(15)  ,XPRES  )
000130      CALL STREN(SSFWSP  ,XPRES  ,IFAIL  )
000132      IF(IFAIL .EQ. 0)  GO TO 25
000135      IFAL(4)  =  IFAL(4) + 1
000136      IFLAG    =  1
000137   25 IF(TXTEN .NE. 0)  GO TO 100
      C ---  NOZZLE LOAD WITHOUT EXTENSION
000140      CALL TRIVAR(XNOZL  ,XLOD  ,1  )
000143      STAT(16)  =  STAT(16) + XLOD
000145      STAT(17)  =  AMIN1(STAT(17)  ,XLOD  )
000150      STAT(18)  =  AMAX1(STAT(18)  ,XLOD  )
000153      CALL STREN(SSNOZL  ,XLOD  ,IFAIL  )
000155      IF(IFAIL .EQ. 0)  GO TO 30
000160      IFAL(5)  =  IFAL(5) + 1
```

```
000161          IFLAG    =  1
                C ---  AFT DOME LOAD NO NOZZLE EXTENSION
000162    30    CALL TRIVAR(AFDL  ,XLOD  ,1  )
000165          STAT(19)  =  STAT(19) + XLOD
000167          STAT(20)  =  AMIN1(STAT(20)  ,XLOD  )
000172          STAT(21)  =  AMAX1(STAT(21)  ,XLOD  )
000175          CALL STREN(SSAFDL  ,XLOD  ,IFAIL  )
000177          IF(IFAIL .EQ. 0)  GO TO 35
000202          IFAL(6)  =  IFAL(6) + 1
000203          IFLAG    =  1
                C ---  AFT SKIRT PRESSURE NO NOZZLE EXTENSION
000204    35    CALL TRIVAR(AFSP  ,XPRES  ,1  )
000207          XPRES = AMAX1(XPRES,0.)
000213          STAT(22)  =  STAT(22) + XPRES
000214          STAT(23)  =  AMIN1(STAT(23)  ,XPRES  )
000217          STAT(24)  =  AMAX1(STAT(24)  ,XPRES  )
000222          CALL STREN(SSAFSP  ,XPRES  ,IFAIL  )
000224          IF(IFAIL .EQ. 0)  GO TO 40
000227          IFAL(7)  =  IFAL(7) + 1
000230    40    IF(IFLAG .EQ. 1)   RETURN
000233          IFAL(1)  =  IFAL(1) + 1
000235          RETURN
                C ---  NOZZLE LOAD WITH NOZZLE EXTENSION
000235    100   CALL TRIVAR(XNOZLX  ,XLOD  ,1  )
000240          STAT(16)  =  STAT(16) + XLOD
000242          STAT(17)  =  AMIN1(STAT(17)  ,XLOD  )
000245          STAT(18)  =  AMAX1(STAT(18)  ,XLOD  )
000250          CALL STREN(SSNOZLX  ,XLOD  ,IFAIL)
000252          IF(IFAIL .EQ. 0)  GO TO 105
000255          IFAL(5)  =  IFAL(5) + 1
000256          IFLAG    =  1
                C ---  AFT DOME LOAD WITH NOZZLE EXTENSION
000257    105   CALL TRIVAR(AFDLX  ,XLOD  ,1  )
000262          STAT(19)  =  STAT(19) + XLOD
000264          STAT(20)  =  AMIN1(STAT(20)  ,XLOD  )
000267          STAT(21)  =  AMAX1(STAT(21)  ,XLOD  )
000272          CALL STREN(SSAFDLX ,XLOD  ,IFAIL  )
000274          IF(IFAIL .EQ. 0)   GO TO 110
000277          IFAL(6)  =  IFAL(6) + 1
000300          IFLAG    =  1
                C ---  AFT SKIRT PRESSURE WITH EXTENSION
000301    110   CALL TRIVAR(AFSPX ,XPRES  ,1  )
000304          XPRES = AMAX1(XPRES,0.)
000310          STAT(22)  =  STAT(22) + XPRES
000311          STAT(23)  =  AMIN1(STAT(23)  ,XPRES  )
000314          STAT(24)  =  AMAX1(STAT(24)  ,XPRES  )
000317          CALL STREN(SSAFSPX ,XPRES  ,IFAIL  )
000321          IF(IFAIL .EQ. 0)   GO TO 120
000324          IFAL(7)  =  IFAL(7) + 1
000325    120   IF(IFLAG .EQ. 1)   RETURN
000330          IFAL(1)  =  IFAL(1) + 1
000332          RETURN
000332          END
```

SUBPROGRAM LENGTH
001476

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000045	L00033	10	000042
000064	L00044	15	NONE
000116	L00064	20	000113
001140	L00101	25	000135
000163	L00120	30	000160
001205	L00135	35	000202
001231	L00153	40	000227
000236	L00160	100	000140
000260	L00175	105	000255
000302	L00212	110	000277
000326	L00230	120	000324

BLOCK NAMES AND LENGTHS
DAMAG - 000007 CNOTNS - 000016 STAT - 000030

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
001047	A00010	AFOL	000163				
001124	A00011	AFOLX	000260				
001201	A00012	AFSP	000205				
001256	A00013	AFSPX	000302				
000354	A00001	CAS1L	000045				
001431	A00002	CAS2L	000005				
000506	A00003	CAS2P	000010				
000563	A00004	CAS3P	000064				
000640	A00005	FWSP	000116				
001473	V00040	IFAIL	000034	000040	000102	000131	000134
			000157	000176	000201	000223	000226
			000254	000273	000276	000320	000323
00100000C01	A00026	IFAL	000234	000331			
001470	V00035	IFLAG	000005	000115	000137	000162	000204
			000257	000301	000326		
001475	V00042	JFAIL	000077	000110			
001474	V00041	KFAIL	000060	000105			
001371	A00017	SSAFOL	000175				
001427	A00022	SSAFOLX	000272				
001403	A00020	SSAFSP	000222				
001441	A00023	SSAFSPX	000317				
001333	A00014	SSCAS1	000057				
001345	A00015	SSCAS3	000076				
001453	A00024	SSFWSP	000130				
001415	A00021	SSNOZL	000153				
001357	A00016	SSNOZLX	000250				

000000003	000032	STAT	000013				
000013002	000031	THETA	NONE				
001465	000025	TH1	NONE				
000010002	000030	VHOR	NONE				
000003002	000027	VVEL	NONE				
001471	000036	XLOD	000006	000013	000032	000045	000050
			000141	000144	000154	000163	000166
			000236	000241	000251	000260	000263
000715	000006	XNOZL	000141				
000772	000007	XNOZLX	000236				
001472	000037	XPRES	000010	000023	000033	000064	000067
			000116	000121	000131	000205	000210
			000302	000305	000320		

START OF CONSTANTS
000335

START OF TEMPORARIES
000342

START OF INDIRECTS
000354

EXTERNAL REFERENCES

SYMBOL	REFERENCES						
TRIVAR	000007	000012	000047	000066	000120	000143	000165
	000240	000262	000304				
SLAP	000036						
STREN	000061	000100	000132	000155	000177	000224	000252
	000321						
END	000334						

UNUSED COMPILER SPACE
000500

```
                SUBROUTINE TRIVAR(TABL  ,XOUT  ,KFLAG  )
C-----------------------------------------------------------------------
C       THIS ROUTINE DOES A SPECIFIC TRIVARIANT INTERPOLATION
C       TABL --- TABLE THAT HAS FUNCTIONAL VALUES IN IT
C       XOUT --- VALUE COMPUTED BY ROUTINE
C       KFLAG -- FLAG TO INDICATE IF A NEW TRIAL IS BEING PROCESSED
C                  IF KFLAG  =  0  NEW TRIAL
C                  IF KFLAG  =  1  OLD TRIAL
C-----------------------------------------------------------------------
000005          COMMON / CNDTNS / VV  ,VH  ,TTH  ,VVEL(5)  ,VHOR(3)  ,THETA(3)
000005          DIMENSION TABL(1)
000005          IF(KFLAG .NE. 0)  GO TO 40
C ---  DO NOT NEED TO RECALCULATE LOCATION SINCE NOT A NEW TRIAL
000006          KK  =  0
000006          JJ  =  0
000007          II  =  0
000010          DO 10 K=1,5
000015          KK  =  6 - K
000016          IF(VVEL(KK) .LE. VV)   GO TO 15
000022    10    CONTINUE
000024    15    IF(KK .EQ. 5)   KK  =  4
000027          DO 21 J=1,3
000034          JJ  =  4 - J
000035          IF(VHOR(JJ) .LE. VH)   GO TO 25
000041    20    CONTINUE
000043    25    IF(JJ .EQ. 3)   JJ  =  2
000046          DO 30 I=1,3
000053          II  =  4 - I
000054          IF(THETA(II) .LE. TTH) GO TO 35
000060    30    CONTINUE
000062    35    IF(II .EQ. 3)   II  =  2
000067          LOC   =  II + 3 * (JJ-1) +  9 * (KK-1)
000073          LOC1  =  LOC + 9
000075          DVV   =  VVEL(KK+1) - VVEL(KK)
000077          DV    =  VV - VVEL(KK)
000100          DVH   =  (VH - VHOR(JJ)) / (VHOR(JJ+1) - VHOR(JJ))
000104          DTH   =  (TTH - THETA(II)) / (THETA(II+1) - THETA(II))
000113    40    G7    =  TABL(LOC1+4)
000114          G6    =  TABL(LOC1+3)
000116          G5    =  TABL(LOC1+1)
000117          G4    =  TABL(LOC1)
000120          G3    =  TABL(LOC+4)
000122          G2    =  TABL(LOC+3)
000123          G1    =  TABL(LOC+1)
000125          G0    =  TABL(LOC)
000126          DG0   =  (G4-G0) / DVV
000130          DG1   =  (G5-G1) / DVV
000132          DG2   =  (G6-G2) / DVV
000135          DG3   =  (G7-G3) / DVV
000140          GA    =  G0 + DV * DG0
000143          GB    =  G1 + DV * DG1
000145          GC    =  G2 + DV * DG2
000150          GD    =  G3 + DV * DG3
000152          GAA   =  GA + DVH * (GC - GA)
000155          GBB   =  GB + DVH * (GD - GB)
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000160          XOUT  =  GAA + OTH * (GB9 - GAA)
000163          RETURN
000163          END
```

SUBPROGRAM LENGTH
000252

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000025	L00025	15	000022
000044	L00041	25	000041
000063	L00055	35	000060
000112	L00066	40	000006

BLOCK NAMES AND LENGTHS
CNOTNS - 000016

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
000240	V00036	DG0	000132	000141			
000241	V00037	DG1	000135	000143			
000242	V00040	DG2	000137	000146			
000243	V00041	DG3	000142	000150			
000227	V00025	DTH	000111	000162			
000225	V00023	DV	000101	000140			
000226	V00024	DVH	000105	000154			
000224	V00022	DVV	000100	000130	000134		
000244	V00042	GA	000144	000153			
000250	V00046	GAA	000156				
000245	V00043	GF	000147	000156			
000251	V00047	GPP	000161				
000246	V00044	GC	000151				
000247	V00045	GD	000153				
000237	V00035	G0	000127	000141			
000236	V00034	G1	000125	000144			
000235	V00033	G2	000124	000137	000146		
000234	V00032	G3	000122	000136	000151		
000233	V00031	G4	000121	000126			
000232	V00030	G5	000120	000131			
000231	V00027	G6	000116	000133			
000230	V00026	G7	000115	000136			
000221	V00016	I	000050	000052			
000216	V00011	II	000010	000055	000063	000071	000104
000220	V00014	J	000031	000033			
000215	V00010	JJ	000010	000036	000044	000066	
000217	V00012	K	000012	000014			
000214	V00007	KK	000007	000017	000025	000067	
000222	V00020	LOC	000074	000112			
000223	V00021	LOC1	000075	000113			
000013C01	000003	THETA	000056				
000002C01	V00017	TTH	000052	000107			
000001C01	V00015	VH	000033	000103			

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          000010001 000002     VHOR       000037     000102
          000000001 VC0013     VV         000014     000077
          000003001 000001     VVEL       000020     000076

START OF CONSTANTS
000166

START OF TEMPORARIES
000167

START OF INDIRECTS
000207

EXTERNAL REFERENCES

          SYMBOL     REFERENCES
          ENT        000165

UNUSED COMPILER SPACE
006300
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```
      SUBROUTINE WRIT(VEL  )
C-----------------------------------------------------------------------
C     THIS ROUTINE WRITES OUT THE DAMAGE CONDITION SUMMARY
C-----------------------------------------------------------------------
000002      COMMON / STAT  / STAT(24)
000002      COMMON / DAMAG / IFAL(7)
000002      COMMON / NUMBER / NTRIAL
000002      COMMON / CSTDAT / PER(7)
000002      XX  =  FLOAT(NTRIAL)
000004      DO 21 J=1,7
000011      PER(J)  =  IFAL(J) / XX
000012   20 CONTINUE
000013      NOSINK  =  NTRIAL - IFAL(2)
000015      STAT(1)  =  STAT(1) / NTRIAL
000017      STAT(4)  =  STAT(4) / NTRIAL
000020      DO 25 J=7,22,3
000025      STAT(J)  =  STAT(J) / NOSINK
000027   25 CONTINUE
000030      WRITE(6,2500)  (STAT(I),I=1,6)
000035      WRITE(6,2501)  (STAT(I),I=7,9)
000044      WRITE(6,2502)  (STAT(I),I=10,12)
000053      WRITE(6,2503)  (STAT(I),I=13,15)
000062      WRITE(6,2504)  (STAT(I),I=16,18)
000071      WRITE(6,2505)  (STAT(I),I=19,21)
000100      WRITE(6,2506)  (STAT(I),I=22,24)
000107      WRITE(6,2999)   VEL  ,NTRIAL
000120      WRITE(6,2001)  IFAL(1)   ,PER(1)
000131      WRITE(6,2002)  IFAL(2)   ,PER(2)
000142      WRITE(6,2003)  IFAL(3)   ,PER(3)
000153      WRITE(6,2004)  IFAL(4)   ,PER(4)
000164      WRITE(6,2005)  IFAL(5)   ,PER(5)
000175      WRITE(6,2006)  IFAL(6)   ,PER(6)
000206      WRITE(6,2007)  IFAL(7)   ,PER(7)
000217 2999  FORMAT(1H1,35X,24HDAMAGE CONDITION SUMMARY,//,
     1       36X,F4.0,11H METERS/SEC,2X,
     2       15HDESIGN VELOCITY,/,
     3       36X,I4,19H MONTE CARLO TRIALS,//,
     4       6X,16HDAMAGE CONDITION,53X,
     5       9HNUMBER OF,8X,8HPROB. OF ,/,
     6       75X,11HOCCURRENCES,6X,10HOCCURRENCE)
000220 2500  FORMAT(1HO,5X,42HLOAD STATISTICS FOR MAX. SLAPDOWN-NOT USED,/,
     1       10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
     2       2X,F10.2,//,
     3       6X,37HHOOP MOMENT FOR MAXIMUM SLAPDOWN     ,/,
     4       10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
     5       2X,F10.2)
000220 2501  FORMAT(1HO,5X,37HLOAD STATISTICS FOR PEAK ACCELERATION,/,
     1       10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
     2       2X,F10.2)
000220 2502  FORMAT(1HO,5X,42HPRESSURE SATISTICS FOR MAXIMUM SUBMERGENCE,/,
     1       10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
     2       2X,F10.2)
000220 2503  FORMAT(1HO,5X,36HPRESSURE SATISTICS FOR FORWARD SKIRT,/,
     1       10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
     2       2X,F10.2)
```

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000220   2504  FORMAT(1HO,5X,27HTHROAT SATISTICS FOR NOZZLE,/,
              1        10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X7HMAXIMUM,
              2        2X,F10.2)
000220   2505  FORMAT(1HO,5X,27HLOAD/PRESSURES FOR AFT DOME,/,
              1        10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
              2        2X,F10.2)
000220   2506  FORMAT(1HO,5X,32HPRESSURE SATISTICS FOR AFT SKIRT,/,
              1        10X,4HMEAN,2X,F10.2,2X,7HMINIMUM,2X,F10.2,2X,7HMAXIMUM,
              2        2X,F10.2)
000220   2001  FORMAT(1HO,5X,9HNO DAMAGE,62X,I4,15X,F6.4)
000220   2002  FORMAT(1HO,5X,7HSINKAGE,64X,I4,15X,F6.4)
000220   2003  FORMAT(1HO,5X,9H2 SEGMENT,62X,I4,15X,F6.4)
000220   2004  FORMAT(1HO,5X,13HFORWARD SKIRT,58X,I4,15X,F6.4)
000220   2005  FORMAT(1HO,5X,6HNOZZLE,65X,I4,15X,F6.4)
000220   2006  FORMAT(1HO,5X,8HAFT DOME,63X,I4,15X,F6.4)
000220   2007  FORMAT(1HO,5X,9HAFT SKIRT,62X,I4,15X,F6.4)
000220         RETURN
000221         END
```

SUBPROGRAM LENGTH
000572

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000507	000263	2001	000121
000514	000270	2002	000132
000521	000275	2003	000143
000526	000302	2004	000154
000534	000310	2005	000165
000541	000315	2006	000176
000546	001322	2007	000207
000303	000057	2500	000030
000347	000123	2501	000036
000367	000143	2502	000045
000407	000163	2503	000054
000427	000203	2504	000063
000447	000223	2505	000072
000467	000243	2506	000101
000226	000002	2999	000110

BLOCK NAMES AND LENGTHS
STAT - 000030 DAMAG - 000007 NUMBER - 000001 CSTOAT - 000007

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES		
000571	V00011	I	NONE		
000000002	A00002	IFAL	000007	000125	
000567	V00007	J	000005	000022	
000570	V00010	NOSINK	000016	000025	
000000003	V00006	NTRIAL	000003	000014	000116
000000004	A00003	PER	000010	000127	
000000001	A00001	STAT	000015	000024	000033
000566	V00005	XX	000004	000010	

START OF CONSTANTS
000224

START OF TEMPORARIES
000553

START OF INDIRECTS
000564

EXTERNAL REFERENCES

SYMBOL	REFERENCES						
OUTPTC	000032	000034	000035	000041	000043	000044	000050

```
            000053  000057  000061  000062  000066  000070  000071
            000077  000100  000104  000106  000107  000113  000115
            000120  000124  000126  000130  000131  000135  000137
            000142  000146  000150  000152  000153  000157  000161
            000164  000170  000172  000174  000175  000201  000203
            000206  000212  000214  000216  000217
      END   000223

UNUSED COMPILER SPACE
005400
```

```
                SUBROUTINE XYZ (X  ,Y  ,Z  )
              C-------------------------------------------------------------------
              C     GIVEN A COLUMN OF MAJOR CYCLE TIMES,X,A COLUMN OF MAJOR CYCLE
              C     VALUES,Y,THIS FUNCTION FITS A THIRD DEGREE POLYNOMIAL TO THE
              C     VALUES OF Y TO COMPUTE THE DESIRED VALUE OF Z AT TIME X.
              C-------------------------------------------------------------------
000005                DIMENSION  X(1)  ,Y(1)  ,Z(1)
000005                K  =  0
000005                J  =  2
000007        5       D  =  (X(J-1)-X(J)) * (X(J)-X(J+1)) * (X(J-1)-X(J+1))
000016                IF (ABS(D) .LE. 1.E-8 ) GO TO 20
000023                Z(K+1)  =  (Y(J-1)-Y(J)) * (X(J)-X(J+1))-(Y(J)-Y(J+1)) *
                     *           (X(J-1)-X(J))
000033                Z(K+2)  =  (X(J-1)-X(J)) * (X(J-1)+X(J)) * (Y(J)-Y(J+1)) -
                     1           (X(J)-X(J+1)) * (X(J)+X(J+1)) * (Y(J-1)-Y(J))
000051                Z(K+3)  =  X(J-1) * X(J) * Y(J+1) * (X(J-1)-X(J)) + X(J+1) *
                     1           X(J-1) * Y(J) * (X(J+1)-X(J-1)) + X(J) * X(J+1) *
                     2           Y(J-1) * (X(J)-X(J+1))
000066                DO 11 I=1,3
000075        10      Z(K+I)  =  Z(K+I) / D
000101        15      IF(K .NE. 0 ) GO TO 40
000102                J  =  3
000103                K  =  3
000104                GO TO 5
000104        20      Z(K+1)  =  0.
000106                IF(X(2) .EQ. X(3) ) GO TO 30
000113                Z(K+2)  =  (Y(3)-Y(2)) / (X(3)-X(2))
000117                Z(K+3)  =  (Y(2) * X(3) - Y(3) * X(2)) / (X(3) - X(2))
000124                GO TO 15
000125        30      Z(K+2)  =  0.
000126                Z(K+3)  =  (Y(2)+Y(3)) / 2.
000131                GO TO 15
000132        40      Z(7)  =  X(2)
000134                Z(8)  =  X(3)
000135                RETURN
000136                END
```

SUBPROGRAM LENGTH
000231

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES	
000110	L00011	5	000104	
000102	L00025	15	000124	000132
000105	L00032	20	000021	
000125	L00040	30	000110	
000133	L00043	40	000102	

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
000227	V00006	D	000016	000072			
000230	V00007	T	000067				
000226	V00005	J	000007	000010	000022	000103	
000225	V00004	K	000006	000023	000070	000102	000105

START OF CONSTANTS
000141

START OF TEMPORARIES
000145

START OF INDIRECTS
000211

EXTERNAL REFERENCES

SYMBOL	REFERENCES
END	000140

UNUSED COMPILER SPACE
006500

```
      FUNCTION EVAL(X  ,T  )
C-----------------------------------------------------------------------
C     GIVEN A COLUMN OF MAJOR CYCLE VALUES,X, AND A TIME T, THIS
C     FUNCTION INTERPOLATES FOR A VALUE CORRESPONDING TO TIME T.
C-----------------------------------------------------------------------
000004      DIMENSION  X(1)
000004      Y  =  (X(1) * T + X(2)) * T + X(3)
000007      Z  =  (X(4) * T + X(5)) * T + X(6)
000013      IF(X(7) .EQ. X(8) ) GO TO 10
000016      ZZ  =  (X(8) - T) / (X(8) - X(7))
000021      EVAL  =  ZZ * Y + (1.- ZZ) * Z
000026      RETURN
000026 10   EVAL  =  (Y + Z) / 2.
000031      RETURN
000032      END
```

SUBPROGRAM LENGTH
000073

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000027	L00015	10	000015

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES		
000067	V00003	EVAL	000026	000031	
000070	V00004	Y	000010	000023	000027
000071	V00005	Z	000013	000024	000027
000072	V00006	Z7	000016		

START OF CONSTANTS
000035

START OF TEMPORARIES
000040

START OF INDIRECTS
000054

EXTERNAL REFERENCES

SYMBOL	REFERENCES
END	000034

UNUSED COMPILER SPACE
007000

```
                SUBROUTINE COSTPLT(RCOST  ,NUM  ,TER  )
              C-----------------------------------------------------------------
              C     THIS ROUTINE PLOTS THE REFURBISHMENT COST VS. TERMINAL VELOCITY
              C     AND THE DEVELOPMENTAL COSTS, REFURBISHMENT COSTS AND THE TOTAL
              C     OF THE TWO
              C     RCOST --- REFURBISHMENT COST FOR THE DESIGN VELOCITIES
              C     NUM ----- TOTAL NUMBER OF DESIGN VELOCITIES
              C     TER ----- ARRAY WITH VARIOUS DESIGN VELOCITIES
              C-----------------------------------------------------------------
J00005                DIMENSION  RCOST(1)  ,TER(1)  ,DEVCST(20)  ,TITLE(6)  ,X(201)  ,
                     1          Y(201)    ,XX(12)   ,YY(12)      ,Z(8)
000005                NAMELIST / DEVEL /  DEVCST
000005                DATA  TITLE  /  10HCOST VS. T  ,10HERMINAL VE   ,10HLOCITY     ,
                     1                10H($ VS. MET  ,10HERS/SEC     ,10H           /
000005                WRITE(6,1010)
000010   1010         FORMAT(1H1,5X,26HREFURBISHMENT COST SUMMARY)
000012                DO 5 I=1,NUM
000014                WRITE(6,1001)  TER(I)  ,RCOST(I)
000031   5            CONTINUE
000034   1001         FORMAT(1H0,5X,11HDESIGN VEL.,F10.2,10X,12HCOST ($/SRB),5X,F10.1)
              C ---    WILL HAVE TO CHANGE YMAX WHEN GET DATA
000034                YMAX  =  4000000.
000035                CALL SPLT(0.  ,20.  ,1H   ,TITLE  ,0.  ,1.  ,0.  ,YMAX  ,  1H   )
000046                DO 10 I=1,201
000055                X(I)  =  I / 2.- .5
000057   10           CONTINUE
000062                YY(1)  =  RCOST(1)
000063                XX(1)  =  TER(1)
000064                NUM1   =  NUM + 1
000065                YY(NUM+2)  =  RCOST(NUM)
000066                XX(NUM+2)  =  TER(NUM)
000070                DO 20 I=2,NUM1
000075                XX(I)  =  TER(I-1)
000076                YY(I)  =  RCOST(I-1)
000100   20           CONTINUE
000101                NUMMN1  =  NUM - 1
000104                DO 30 I=1,NUMMN1
000107                IST  =  XX(I+1) + 1
000111                ISP  =  XX(I+2)
000113                CALL XY2(XX(I)  ,YY(I)  ,7  )
000116                DO 30 II=IST,ISP
000122                Y(II)  =  EVAL(Z  ,X(II)  )
000127                CALL FPLT(X(II)  ,Y(II)  )
000134   30           CONTINUE
000141                CALL SPLT(0)
              C ---    ADD MORE WHEN GET DEVELOPMENT COSTS DATA
000143                STOP
000147                END
```

SUBPROGRAM LENGTH
001147

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000161	000002	1000	000005
000166	000007	1001	000014

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES				
001224	A00001	CEVCST	000154				
001140	V00013	I	000014	000020	000024	000032	000052
			000106	000137			
001146	V00021	II	000122	000126	000135		
001145	V00020	ISP	000113	000135			
001144	V00017	IST	000112	000120			
001143	V00016	NUMMN1	000104	000140			
001142	V00015	NUM1	000066	000073			
001250	A00002	TITLE	000037				
001256	A00003	X	000054				
001100	A00005	XX	000064	000074			
000567	A00004	Y	NONE				
001141	V00014	YMAX	000035	000043			
001114	A00006	YY	000063	000074			
001130	A00007	Z	000115	000123			

START OF CONSTANTS
000157

START OF TEMPORARIES
000212

START OF INDIRECTS
000216

EXTERNAL REFERENCES

SYMBOL	REFERENCES					
OUTPTC	000007	000010	000016	000022	000026	000027
SPLT	000041	000046				
XYZ	000116					
EVAL	000125					
FPLT	000132					
EPLT	000143					
STOP	000147					
END	000151					

UNUSED COMPILER SPACE
006300

```
      SUBROUTINE SPNRN1 (A,B,R)
C
C                    SUBROUTINE  SPNRNC   NORMALIZED RANDOM NUMBERS
C     A EQUALS THE MEAN OF THE NORMAL CURVE.
C     B EQUALS THE STANDARD DEVIATION OF THE CURVE
C     R IS THE INITIAL NUMBER INPUT AND CONTAINS THE RANDOM
C     NUMBER WHEN THE RETURNED TO THE CALLING PROGRAM.
C     RANF MUST BE INITIALIZED IN THE CALLING RCLTINE WITH A
C     FUNCTION STATEMENT LIKE, RANF(X) WHERE X IS .GT. ZERO.
C
000005      R              =RANF(0.)
000010      Z              =R+0.
000011      IF (Z.GT.0.5)                  Z=1.0-Z
000016      E              =SQRT(ALOG(1.0/(Z*Z)))
000025      XN             =2.515517+E*(.802853+.010328*E)
000030      XD             =1.0+E*(1.432788+E*(.189269+.001308*E))
000036      XQ             =E-XN/XD
000037      IF (R.LT.0.5)                  XQ=-XQ
000045      R              =A+B*XQ
000047      RETURN
000050      END
```

SUBPROGRAM LENGTH
000116

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES		
000112	V000005	E	000025		
000114	V000007	XD	000036		
000113	V000006	XN	000032		
000115	V000010	XQ	000042	000046	
000111	V000004	Z	000012	000016	000017

START OF CONSTANTS
000053

START OF TEMPORARIES
000070

START OF INDIRECTS
000111

EXTERNAL REFERENCES

SYMBOL	REFERENCES
RANF	100006
ALOG	000022
SQRT	100024
END	000052

UNUSED COMPILER SPACE
006700

6.0 SAMPLE INPUT

```
P$INPUT1 NUMMC = 500, NUMVTO = 3  ,IXX = 0  ,IRANF = 1 $
P$INPUT2 W1IN =  0.       ,W2IN =  0.       ,TH1IN  =  0.  ,TH2IN =0.14,
         VPTIN =  0.      ,VPTSIG = 0.       ,XLP = 62.5    ,
         VORNT =  1.286   ,VORNTSI = .593    ,
         PTHW(1) = 0.0000  ,0.3125  ,0.1250  ,0.28125   ,.5000    ,
                   .71875 ,.87500  ,0.96875 ,1.0    ,
         THW1(1) = -1.570796  ,-1.178097  ,-.785398  ,-.392699  ,0.0  ,
                    .392699  ,  .785398  ,1.178097  ,1.570796  $
C     COSTS FOR NO EXTENSION
P$COSTS  COST(1)  =  .324E+6  ,2.50E+6  ,.296E+6  ,.183E+6  ,.09E+6,
         COST(6)  =  .19E+6  ,.208E+6  $
C     COSTS FOR EXTENSION
C$COSTS  COST(1)  =  .771E+6  ,2.50E+6  ,.296E+6  ,.183E+6  ,.106E+6  ,
C        COST(6)  =  .19E+6  ,.208E+6  $
P$INPUT3 VTOIN  =  21.3  ,  VTOSIG = 1.065 $
P$INPUT3 VTOIN  =  30.5  ,  VTOSIG = 1.525 $
P$INPUT3 VTOIN  =  39.7  ,  VTOSIG = 1.985 $
```

7.0 SAMPLE OUTPUT

```
 TERMIAL DESIGN VELOCITY  21.32  METERS/SEC

LOAD STATISTICS FOR MAX. SLAPDOWN-NOT USED
    MEAN        0.    MINIMUM        0.    MAXIMUM        0.

HOOP MOMENT FOR MAXIMUM SLAPDOWN
    MEAN     7319.69  MINIMUM     5345.54  MAXIMUM    16435.15

LOAD STATISTICS FOR PEAK ACCELERATION
    MEAN     7012.51  MINIMUM     2909.64  MAXIMUM    13041.07

PRESSURE SATISTICS FOR MAXIMUM SUBMERGENCE
    MEAN       10.71  MINIMUM        3.20  MAXIMUM       13.81

PRESSURE SATISTICS FOR FORWARD SKIRT
    MEAN       55.66  MINIMUM       44.13  MAXIMUM      191.48

THROAT SATISTICS FOR NOZZLE
    MEAN     3083.08  MINIMUM     2269.58  MAXIMUM     4205.14

LOAD/PRESSURES FOR AFT DOME
    MEAN       86.07  MINIMUM       67.54  MAXIMUM      119.37

PRESSURE SATISTICS FOR AFT SKIRT
    MEAN       14.96  MINIMUM         .44  MAXIMUM       44.31
```

DAMAGE CONDITION SUMMARY

21 METERS/SEC DESIGN VELOCITY
500 MONTE CARLO TRIALS

DAMAGE CONDITION	NUMBER OF OCCURRENCES	PROB. OF OCCURRENCE
NO DAMAGE	0	0
SINKAGE	5	.0100
2 SEGMENT	10	.0200
FORWARD SKIRT	495	.9900
NOZZLE	0	0
AFT DOME	484	.9680
AFT SKIRT	0	0

NUMBER OF LAUNCHES FOR EACH MONTH

JAN --	42	FEB --	41	MAR --	42	APR --	42
MAY --	41	JUN --	42	JUL --	42	AUG --	41
SEP --	42	OCT --	42	NOV --	41	DEC --	42

IMPACT ANGLE (RADIANS) FOR STEPS OF .05 PROBABILITY

-.1389	-.1321	-.1236	-.1140
-.0990	-.0932	-.0865	-.0821
-.0234	-.0080	.0115	.0288
.0446	.0620	.0815	.0972
.1129	.1228	.1319	.1373

MINIMUM VALUE	-.1400
MAXIMUM VALUE	.1400
MEAN	-.0008
SIGMA	.0940
MEDIAN	.0019
NINETY NINE PERCENT	.1386

HORIZONTAL IMPACT VELOCITY(M/S) FOR STEPS OF .05 PROBABILITY

1.2584	2.1416	2.7557	3.2623
3.7242	4.1379	4.4671	5.0825
5.4683	5.8164	6.3264	6.9453
7.4684	8.0938	8.7566	9.6570
10.5433	11.6954	13.1167	15.2839

MINIMUM VALUE	.2279
MAXIMUM VALUE	19.1219
MEAN	6.7961
SIGMA	3.7207
MEDIAN	5.9486
NINETY NINE PERCENT	15.9673

VERTICAL IMPACT VELOCITY (M/S) FOR STEPS OF .05 PROBABILITY

19.0853	19.6862	20.0243	20.3145
20.5205	20.6866	20.8247	20.9581
21.0738	21.2264	21.3319	21.4371
21.5554	21.6976	21.8121	21.9735
22.1977	22.4047	22.7432	23.5524

MINIMUM VALUE	17.7262
MAXIMUM VALUE	25.0221
MEAN	21.2559
SIGMA	1.0490
MEDIAN	21.2735
NINETY NINE PERCENT	23.7195

HOOP MOMENT ON CASE (IN-LB/IN)) FOR STEPS OF .05 PROBABILITY

5557	5704	5831	5911
6040	6123	6258	6376
6528	6693	6866	7068
7220	7449	7797	8165
8620	9522	10251	12276

MINIMUM VALUE	5747
MAXIMUM VALUE	16435
MEAN	7320
SIGMA	1721
MEDIAN	6769
NINETY NINE PERCENT	12755

HOOP MOMENT CAPABILITY) FOR STEPS OF .05 PROBABILITY

10229	10782	10991	11145
11284	11399	11503	11603
11702	11804	11927	12041
12137	12212	12304	12435
12528	12701	12889	13381

MINIMUM VALUE	9733
MAXIMUM VALUE	14213
MEAN	11859
SIGMA	791
MEDIAN	11855
NINETY NINE PERCENT	13473

TERMIAL DESIGN VELOCITY 30.50 METERS/SEC

LOAD STATISTICS FOR MAX. SLAPDOWN-NOT USED
MEAN 0. MINIMUM 0. MAXIMUM 0.

HOOP MOMENT FOR MAXIMUM SLAPDOWN
MEAN 7417.00 MINIMUM 5363.39 MAXIMUM 15760.04

LOAD STATISTICS FOR PEAK ACCELERATION
MEAN 12708.59 MINIMUM 5760.46 MAXIMUM 23683.19

PRESSURE SATISTICS FOR MAXIMUM SUBMERGENCE
MEAN 13.23 MINIMUM 3.95 MAXIMUM 19.88

PRESSURE SATISTICS FOR FORWARD SKIRT
MEAN 55.11 MINIMUM 43.94 MAXIMUM 102.83

THROAT SATISTICS FOR NOZZLE
MEAN 4820.85 MINIMUM 3544.13 MAXIMUM 6793.59

LOAD/PRESSURES FOR AFT DOME
MEAN 136.38 MINIMUM 101.77 MAXIMUM 186.56

PRESSURE SATISTICS FOR AFT SKIRT
MEAN 8.71 MINIMUM 0. MAXIMUM 35.84

DAMAGE CONDITION SUMMARY

36 METERS/SEC DESIGN VELOCITY
500 MONTE CARLO TRIALS

DAMAGE CONDITION	NUMBER OF OCCURRENCES	PROB. OF OCCURRENCE
NO DAMAGE	0	0
SINKAGE	3	.0060
2 SEGMENT	18	.0360
FORWARD SKIRT	497	.9940
NOZZLE	1	.0020
AFT DOME	497	.9940
AFT SKIRT	0	0

NUMBER OF LAUNCHES FOR EACH MONTH

JAN --	42	FEB --	41	MAR --	42	APR --	42
MAY --	41	JUN --	42	JUL --	42	AUG --	41
SEP --	42	OCT --	42	NOV --	41	DEC --	42

VERTICAL IMPACT VELOCITY (M/S) FOR STEPS OF .05 PROBABILITY

27.5205	28.3589	28.7873	29.1119
29.4221	29.6420	29.8677	30.0658
30.2455	30.4297	30.6396	30.8651
31.0964	31.3293	31.5151	31.7499
32.0227	32.3721	32.7648	33.8193

MINIMUM VALUE	25.5649
MAXIMUM VALUE	34.9583
MEAN	30.5819
SIGMA	1.5394
MEDIAN	30.5254
NINETY NINE PERCENT	34.1392

HOOP MOMENT ON CASE (IN-LB/IN)) FOR STEPS OF .05 PROBABILITY

5550	5711	5930	5970
6077	6195	6316	6477
6654	6798	6890	7131
7335	7578	7957	8347
8904	9463	10406	12632

MINIMUM VALUE	5363
MAXIMUM VALUE	15760
MEAN	7417
SIGMA	1775
MEDIAN	6975
NINETY NINE PERCENT	13263

HOOP MOMENT CAPABILITY) FOR STEPS OF .05 PROBABILITY

10350	10566	10752	10996
11364	11451	11585	11682
11811	11903	11984	12072
12170	12248	12331	12420
12510	12676	12887	13311

MINIMUM VALUE	9683
MAXIMUM VALUE	14019
MEAN	11996
SIGMA	710
MEDIAN	11945
NINETY NINE PERCENT	13437

TERMIAL DESIGN VELOCITY 33.70 METERS/SEC

LOAD STATISTICS FOR MAX. SLAPDOWN-NOT USED

MEAN	0.	MINIMUM	0.	MAXIMUM	0.

HOOP MOMENT FOR MAXIMUM SLAPDOWN

MEAN	7393.59	MINIMUM	5302.64	MAXIMUM	17156.80

LOAD STATISTICS FOR PEAK ACCELERATION

MEAN	21261.03	MINIMUM	7571.33	MAXIMUM	42222.80

PRESSURE SATISTICS FOR MAXIMUM SUBMERGENCE

MEAN	16.52	MINIMUM	4.70	MAXIMUM	25.15

PRESSURE SATISTICS FOR FORWARD SKIRT

MEAN	54.55	MINIMUM	43.55	MAXIMUM	102.51

THROAT SATISTICS FOR NOZZLE

MEAN	7111.87	MINIMUM	4725.61	MAXIMUM	9582.54

LOAD/PRESSURES FOR AFT DOME

MEAN	202.89	MINIMUM	143.75	MAXIMUM	269.25

PRESSURE SATISTICS FOR AFT SKIRT

MEAN	2.66	MINIMUM	0.	MAXIMUM	26.59

DAMAGE CONDITION SUMMARY

40 METERS/SEC DESIGN VELOCITY
500 MONTE CARLO TRIALS

DAMAGE CONDITION	NUMBER OF OCCURRENCES	PROB. OF OCCURRENCE
NO DAMAGE	0	0
SINKAGE	5	.0100
2 SEGMENT	14	.0280
FORWARD SKIRT	495	.9900
NOZZLE	140	.2800
AFT DOME	495	.9900
AFT SKIRT	0	0

NUMBER OF LAUNCHES FOR EACH MONTH

JAN --	42	FEB --	41	MAR --	42	APR --	42
MAY --	41	JUN --	42	JUL --	42	AUG --	41
SEP --	42	OCT --	42	NOV --	41	DEC --	42

VERTICAL IMPACT VELOCITY (M/S) FOR STEPS OF .05 PROBABILITY

35.8647	36.9731	37.6247	37.9526
38.3354	38.5643	38.8103	39.1270
39.2933	39.6149	39.9523	40.2633
40.5006	40.6991	40.9473	41.3129
41.6310	42.0933	42.7116	44.0108

MINIMUM VALUE	34.5911
MAXIMUM VALUE	47.3826
MEAN	39.8199
SIGMA	1.9824
MEDIAN	39.7740
NINETY NINE PERCENT	44.3595

HOOP MOMENT ON CASE (IN-LB/IN)) FOR STEPS OF .05 PROBABILITY

5523	5726	5955	5965
6075	6178	6356	6484
6595	6685	6881	7100
7343	7565	7820	8302
8862	9410	10234	12915

MINIMUM VALUE	5303
MAXIMUM VALUE	17157
MEAN	7394
SIGMA	1814
MEDIAN	6769
NINETY NINE PERCENT	14096

HOOP MOMENT CAPABILITY) FOR STEPS OF .05 PROBABILITY

10507	10869	11083	11229
11359	11455	11553	11666
11772	11863	11934	12040
12145	12246	12347	12447
12603	12764	12936	13338

MINIMUM VALUE	9933
MAXIMUM VALUE	13921
MEAN	11908
SIGMA	707
MEDIAN	11836
NINETY NINE PERCENT	13457

REFURBISHMENT COST SUMMARY

DESIGN VEL.	21.30	COST ($/SRB)	1211530.0
DESIGN VEL.	30.50	COST ($/SRB)	1215626.0
DESIGN VEL.	39.70	COST ($/SRB)	1234618.0